Effects of a new schoolyard design on pupil's well-being, restoration, physical fitness and cognitive functioning

by Christina Kelz

EFFECTS OF A NEW SCHOOLYARD DESIGN ON PUPIL'S WELL-BEING, RESTORATION, PHYSICAL FITNESS AND COGNITIVE FUNCTIONING

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ABSTRACT

The present study investigates the effects of a participatory schoolyard redesign on the pupils' psychological well-being, restoration state, physical fitness and cognitive functioning. Furthermore, the potential interaction of regular exposure to greenery with the impact of the new schoolyard was examined.

The study employed a longitudinal quasi-experimental design with two times of measurement; one before and one after the installation of the new schoolyard features. The study included a total of 195 pupils from the test school (new schoolyard) and two control schools (no new schoolyard).

The results indicate positive effects of the new schoolyard especially on psychological well-being, restoration and physical fitness. No significant influences on cognitive functioning were found. Children's regular exposure to greenery in their home environment did not moderate the effect of the schoolyard.

Also, the perception of the new schoolyard was highly positive and pupils as well as teachers are more inclined to use it than the old one. Implications for future research and design projects are discussed.

BIOGRAPHICAL SKETCH

Christina Kelz was born on 7th of May in 1983 in Austria. She visited the BG/BRG Gleisdorf (where the present study was performed at) with a focus on psychology and languages.

After school she attended Karl-Franzens-University in Graz and received the Master of Science in Psychology in May 2006. From 2006 till 2008 she worked as a teaching assistant at the Institute of Psychology at Karl-Franzens-University Graz.

While working for the Institute of Non-Invasive Diagnostics at Joanneum Research from 2004 to 2008, she gained experience in the practical application of experimental research.

In 2008 she earned a Fulbright Scholarship to attend Cornell University to study Human-Environment-Relations, which was and still is the research field she is most interested in.

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Secondly, I want to thank my mother, Renate Kelz who was affiliated with the school, the study was performed at. She was the one who initiated the whole project by convincing the school's principal to finally realize the long intended redesign of the schoolyard. As I was in America during the installation of the schoolyard (which is in Austria) my Mom was the one who followed and pushed the redesign process, so that the study schedule stayed on time.

Also, I want to thank my father, Willibald Kelz, who was so generous to make a donation to the school, so the proposed drinking fountain (one of the proposed redesign features) could be installed.

Many thanks also to the principal of the BG/BRG Gleisdorf who gave me plenty of scope in redesigning the schoolyard and who provided the school's premises for the test sessions.

Of course, I also want to thank all the school's principals of the control schools (Sonnenhauptschule Gleisdorf & Europahauptschule Gleisdorf) that gave their consent to have their pupils' participate in the study during school hours. And thanks to all the many pupils that were willing to participate and did a great job during the test sessions.

And last but not least, I want to thank my boyfriend, Pierre Flitsch, who was the second experimenter during all the test sessions and helped me to keep the pupils (and me☺) less nervous.

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INTRODUCTION

This study investigates the effects of a newly designed schoolyard on well-being, restoration, physical fitness and cognitive functioning of 13-14 year-old pupils.

The study was performed at the BG/BRG Gleisdorf (grammar school) in Gleisdorf (Austria). From talking to the school's principal and some pupils it became clear that the current schoolyard was not very attractive and underutilized. Therefore, the schoolyard was renovated in order to better fit pupils' needs. This was also believed to increase the usage of the yard and enhance pupils' recess times by spending more time outdoors than indoors during breaks.

A control group was recruited from the Sonnenhauptschule Gleisdorf (secondary modern school) and the Europahauptschule (secondary modern school) that are both located in the same city.

Aims of the study

The aims of the study were first of all, an inclusion of the pupils in the redesign of the schoolyard to ensure a fit of the new schoolyard to the pupils' needs.

Secondly, the redesign should reflect scholarly research and analysis, like the provision of more greenery which is said to affect people positively.

Finally, the pupils' well-being, restoration, physical fitness and cognitive functioning should rise by an increased usage of the new schoolyard.

An empirical evaluation of the schoolyard was performed to document the potential benefits of the new schoolyard. Data were collected before and

after the installation of the new schoolyard from this school and two comparison schools.

THEORETICAL BACKGROUND

The following chapters will present relevant literature that constitutes the background for the aims of the study.

First, effects of physical activity on all dependent variables (physical health, psychological well-being and restoration, and cognitive functioning) used in the current study are summarized.

The next literature chapter treats how nature or greenery can affect these variables.

Finally, design principles for schoolyards and its' influences are proposed and the benefits of participatory design are explained.

Physical Activity

Most people implicitly know and feel that being outdoors and being physically active is good for one's health. The World Health Organization (WHO, 2004) recommends that 5-18-year-old children should be physically active for at least 60 minutes a day. Ideally such activity should take place outdoors to improve children's health and physical development (Corson, 2003). The remainder of the introduction summarizes different beneficial effects of physical activity in children.

Effects of physical activity on physical health

The beneficial effects of physical activity on health are very well documented in adults (Warburton, Nicol, & Bredin, 2006; Sallis, Prochaska, & Taylor, 2000). For young children between 10 and 12 years, Pate, Dowda and Ross (1990) found that physical activity and physical fitness are significantly associated. Sallis et al. (2000) documented modest relationships between physical activity and physical fitness for adolescents. Physical activity during youth seems to be of particular importance as it not only influences current physical fitness and health but also predicts subsequent health status and physical fitness in adulthood (Twisk, Kemper, & van Mechelen, 2002). According to Boreham and Riddoch (2001), three main benefits of regular physical activity during childhood and youth have been documented. First of all, more physically active children are healthier than their lesser active counterparts. Secondly, Boreham and Riddoch (2001) propose a biological carryover effect into adulthood, whereby improved adult health status results from childhood health status. Finally, there might also be a behavioral carryover effect, whereby physically active children are more likely to stay physically active as adults.

Numerous biological mechanisms are involved in the reduction of chronic diseases and premature death that can be traced back to regular physical activity and physical fitness (Warburton et al., 2006). For instance, low blood pressure is an important determinant of health in adult life and childhood blood pressure levels significantly influence blood pressure in adulthood (Fraser, Philips & Harris, 1983). For adolescents between 10 and 14 years the amount of physical activity is inversely related to body weight, body mass index, systolic and diastolic blood pressure and pulse rate (Tell, &

Vellar, 1988).For preadolescent boys higher physical activity is associated with lower blood pressure (Al-Hazzaa, Sulaiman, Al-Matar, & Al-Mobaireek, 1994). Another study by Boreham, Twisk, Savage, Cran, and Strain (1997) also found a significant inverse correlation between the amount of physical activity and systolic blood pressure for adolescents.

Effects of physical activity on psychological variables

Adolescence is stressful for many youth and one potential buffering mechanism of stressful events might be physical activity (Brown, & Lawton, 1986). Adolescents that report higher frequencies of physical activity perceive lower levels of stress (Norris, Carroll, & Cochrane, 1992).
Steptoe, and Butler (1996) found that higher participation in vigorous sport and recreational activities was associated with greater emotional wellbeing, independent of gender, social class, and recent illnesses. That psychological well-being is increased by physical activity in children and adolescents was also reported by Armstrong (1999). The reason for mood being improved by physical activity is because vigorous physical activity enhances the production of serotonin, a neurotransmitter with antidepressant properties (Nash, 1996). Significant short term increases of positive mood and decreases of negative mood following physical activity compared to watching a video have been documented in nine and ten year old children (Williamson, Dewey, & Steinberg, 2001). In particular, “vitality” is elevated following physical activity (Rejeski, Gauvin, Hobson, & Norris, 1995).

Aside from enhancing psychological well-being and mood, physical activity also lowers sadness in adolescents (Brosnahan, Steffen, Lytle, Patterson, & Boostrom, 2004). Furthermore, adolescents who exercise every

day are less likely to attempt suicide than those who exercise only once a week or never (Ferron, Narring, Cauderay, & Michaud, 1999). A more recent study from Motl, Birnbaum, Kubik, and Dishman (2004) found that changes in physical activity were inversely correlated with changes in depressive symptoms in 14-15 year old girls and boys. Norris et al. (1992) also found that physical activity was inversely correlated with depression.

Paffenbarger, Lee, and Leung (1994) revealed in a study that physical activity during childhood and adolescents led to less depression 25 years later, which further supports the theory of the positive carry-over effects of physical activity from youth to adulthood (Boreham, & Riddoch, 2001). Furthermore, increased high-level physical activity has been linked to the development of self-esteem, self efficacy and social competence in children (Strauss, Rodzilsky, Burack, & Colin, 2001; Strong et al., 2005).

Effects of physical activity on cognitive functioning

The concept of “Mens sana in corpere sano” (a healthy mind in a healthy body) existed for many years (Decimus Junius Juvenalis, 140 AD)

Physical activity improves concentration, memory and academic performance in children and adolescents (Taras, 2005). Caterino, and Polak (1999) found that fourth graders who participated in moderate physical activity (walking) for 15 minutes had better outcomes in the Woodcock-Johnson Test of Concentration immediately afterward than a control group that only did stretching. Another study by Graf et al. (2003) reported a significant association between the level of body coordination and concentration for primary school children.

Field, Diego, and Sanders (2001) found a significant difference in the Grade Point Average of high school seniors between a high- and a low-exercise group (median split for frequency of exercise). Kim et al. (2003) also found that physical fitness scores and the Grade Point Average of Korean children from grades five, eight and 11 were significantly associated. A few studies even suggest that there is a relative increase in academic performance per unit of time of physical activity (Sibley, & Etnier, 2003).

Generally, literature on effects of physical activity on cognitive functioning concentrates more on elderly samples with a few studies on elementary school children. For adolescents there are insufficient numbers of well-conducted studies to draw conclusions (Fox, 1999).

Effects of the school environment on physical activity

Demographic differences and cognitive, affective and social correlates are only able to explain a small proportion of the variance of physical activity behavior (King, Stokols, Talen, Brassington, & Killingsworth, 2002). Haug, Torsheim, Sallis, and Samdal (2008) suggest that new models which intend to promote physical activity need to take environmental factors into account.

As school attendance is compulsory, most children attend school, and therefore the school environment can be used as a setting to encourage physical activity (World Health Organization [WHO], 2004). Recess periods and breaks offer numerous opportunities for pupils to involve in unstructured physical activity and play (Wechsler, Devereaux, Davis, & Collins, 2000), as they usually comprise at least 1/6 of a school day. Ridgers, Stratton, and Fairclough's (2006) review concludes that pupils' physical activity and play

during recess periods can contribute between 5 – 40% to the 60 minutes of physical activity a day recommended by the WHO (2004).

School playgrounds are more comparable to adult recreational environments than physical education classes and are therefore important to prime pupils for life-long engagement in physical activity (Zask, van Beurden, Barnett, Brooks, and Dietrich, 2001). So far, a few studies have investigated the effects of singular or multiple characteristics of the outdoor school environment on pupils' physical activity during recess periods (Haug et al., 2008). Sallis et al. (2001) found that a school's outdoor area size and fixed outdoor equipment, and improvements in terms of adding features like volleyball nets or basketball baskets to outdoor school environments explain a substantial amount of the variance in pupils' noncurricular physical activity at school. Another observational study found significant positive correlations of pupils' physical activity during recess periods with the number of available balls in the schoolyards. At the same time, school size (number of pupils) was negatively related to pupils' physical activity (Zask et al., 2001). Two randomized controlled studies, one in secondary schools (Sallis et al., 2003; McKenzie, Marshall, Sallis, & Conway, 2000) and one in elementary schools (Verstraete, Cardon, De Clercq, & De Bourdeaudhuij, 2006), revealed that the provision of additional physical activity and game equipment significantly enhanced pupils physical activity throughout the school day. Barnett, O'Loughlin, Gauvin, Paradis, and Hanley (2006) did another study in an elementary school finding that the amount of storage amenities, ease of access to sports equipment and facilities at school were positively associated with pupils' physical activity. One simple intervention to increase physical

activity at school is the color-coding of activity areas on school grounds (Stratton, & Mullan, 2005; Ridgers, Stratton, Fairclough, & Twisk, 2007).

The findings above are congruent with “behavior setting” theory. Within a defined physical setting, environmental factors can afford or suppress specific behaviors. Applying behavior setting theory to school environments where environmental factors could support physical activity, could result in pupils becoming more physically active (Barnett et al., 2006; Owen, Leslie, Salmon, & Fotheringham, 2000).

Nature and Greenery

Preference for nature

Humans prefer wild and landscaped nature over built environments (Van den Berg, Hartig, & Staats, 2007). Several studies concentrating on children found that children value environments the most which are predominated by natural features (Korpela, 2002). Elsley (2004), for instance, found that children like fields and woods the most and Loukaitou-Sideris (2003) revealed that the presence of natural elements like trees and flowers are important to children.

In newer studies however children’s preference for nature declines in surroundings where children have little access to natural spaces (Castonguay, & Jutras, 2009). In a study by Korpela, Kytta, and Hartig (2002) children’s most favorite places turned out to be play and sports settings. In Min and Lee’s (2006) study, community service and retail places were most liked by children.

The reasons for children to like a place are usually inherent characteristics that provide opportunities for activities children like and to meet friends (Korpela et al., 2002; Loukaitou-Sideris, 2003; Min, & Lee, 2006). Also, Zube, Pitt, and Evans (1983) found that children tend to prefer less naturalistic and less complex landscapes in comparison to adult preferences. Yet outdoor public spaces which provided trees and vegetation were used more frequently by adults and adolescents (Coley, Kuo, & Sullivan, 1997). Findings on humans' general preference for nature and greenery imply that exposure to green environments should have beneficial effects on humans' restoration, well-being and health (Wells, & Evans, 2003).

Effects of nature on restoration

Restoration can be roughly defined as the process of renewing diminished functional resources and capabilities. Multiple processes are involved during restoration that include positive shifts in mood, decline in arousal and improved task performance (Hartig, & Staats, 2003).

One of the oldest and most popular theories about nature as a restorative environment is the Attention Restoration Theory (ART) by Kaplan and Kaplan (1989). Kaplans' (1989) ART suggests that natural environments can help restore mental fatigue which develops after a prolonged period and/or intensive use of directed attention. Signs of directed attentional fatigue include difficulty in concentrating, increased irritability, mood declines, autonomic arousal rises, and increased rate of errors in concentration tasks (Hartig, & Staats, 2003; Van den Berg, Hartig, & Staats, 2007).

ART proposes four major components of restorative environments: being away, fascination, extent and compatibility (Kaplan, 1995).

Being away refers to the experience of not only being in a different surrounding but also having the feeling that one can escape from unwanted distractions in the surroundings, distancing oneself from one's daily routine and reminders of it, and suspending the pursuit of particular purposes (Hartig, Kaiser, & Bowler, 1997).

Fascination is said to be the counterpart to directed attention in terms of effort (Hartig et al., 1997). Natural environments hold "soft" fascinations like clouds, sunsets, and motions of leaves that do not afford effort and leave the opportunity to think about other things (Kaplan, 1995).

A sense of extent is encouraged by natural environments that relates to the coherence in the experience of the environment and the scope for continued exploration (Van den Berg et al., 2007).

Compatibility, finally, is the degree to which the affordances and requirements of the environment match and support the person's goals and inclinations (Van den Berg et al., 2007).

Another important perspective on restoration is the psycho-evolutionary theory (Ulrich, 1983). Due to the fact that humans evolved in natural environments over a long period, people are physiologically and psychologically better adapted to natural than to urban settings. In Ulrich's (1983) theory, restoration applies to a broader context than attentional capacity. Ulrich understands restoration as stress reduction and stress can occur even when directed attention is not fatigued (Joye, 2007) which is an important difference to the Attention Restoration Theory. Ulrich (1983) says that depending on the characteristics of a natural setting, and the individual's preceding affective/cognitive/physiological state, adaptive responses can range from stress and avoidance behavior to restoration and approach

behavior (seeking out, staying in, not avoiding). Restorative responses usually occurred in natural, unthreatening settings like savannas. Ulrich (1983) states that the stress-reducing effect of nature is still effective nowadays because individuals that could restore better from nature after stressful situations were more likely to survive.

There is a growing body of literature concerning the restorative effects of contact with nature (Van den Berg et al., 2007). Based on the available literature to date, the report from the Health Council of the Netherlands (2004) suggests five main benefits of nature exposure:

- recovery from stress and attentional fatigue
- encouragement to exercise
- facilitation of social contacts
- encouragement of optimal development in children
- opportunities for personal development.

Effects of nature on physical restoration and health

Exposure to nature has been found to have numerous positive effects on physiological parameters and physical health compared to exposure to urban environments (Ulrich, 1981).

In one of his earliest and most popular studies, Ulrich (1984) randomly assigned recovering hospital patients that had had surgery, either to rooms with a natural view or to rooms with window views at a brick wall. The patients in the rooms with the nature view used fewer and less potent analgesics, had fewer negative staff evaluations and were released from the hospital sooner compared to the patients in the rooms with the brick wall view (Ulrich, 1984). In another study, exposure to nature -after confronting subjects with a

stressor- has proven to enhance physiological recovery measured with electromyography, skin conductance, pulse transit time (Ulrich, 1979) and electroencephalography (Ulrich, 1981).

One of the main findings of a study by Laumann, Gärling, and Stormark (2003) was that the heart rate in subjects watching a video with natural scenes was significantly lower (measured as a difference from the baseline) than in those watching a video depicting urban scenes. While the heart rate for the "nature group" decreased from the baseline to the video phase, the heart rate of the "urban group" did not significantly change in any direction from the baseline to the video phase. Kahn et al. (2008) found heart rate recovery from low level stress was greater in participants who viewed nature through a window than for those who viewed the same nature scenes on a plasma screen of equal size or for those who did only look at a blank wall.

Also, blood pressure has been found to be sensitive to nature exposure. Hartig, Evans, Jammer, Davis, and Gärling (2003) found that sitting in a room with a nature view after a stressful task caused a decline in diastolic blood pressure while the diastolic blood pressure in subjects sitting in a room with no view increased. Subjects then had to go for a walk either in a forest where the diastolic blood pressure further decreased or in an urban environment which caused a further increase in blood pressure.

In another study comparing the effects of natural versus urban scenes on restoration, a quicker recovery from stress was found for cardiac interbeat-interval, systolic blood pressure and skin conductance response in the natural setting than in the urban setting (Parsons, Tassinary, Ulrich, Hebl, & Grossman-Alexander, 1998). Easy access to green space has also been

shown to be significantly correlated with undertaking activities outdoors and therefore enhancing physical exercise levels (Ewing, 2005).

Another important environmental influence on health is natural light. We know that sun light supports the production of serotonin (Lambert, Reid, Kaye, Jennings, & Esler, 2002) and vitamin D (Glerup et al., 2000) which further improves health (Reichel, Koeffler, & Norman, 1989) and well being (Young, & Leyton, 2002). Natural light has benefits over electric light sources in regulating circadian rhythms and maintaining overall health and is generally the preferred source of light for most people (Edwards, & Torcellini, 2002). Also, natural light reduces depression and fatigue and increases the ability to focus attention (Malkin, 2006).

Effects of nature on psychological well-being

Natural environments are said to be “healing” and “therapeutic”; terms which refer to a favorable process that supports overall well-being (Cooper-Marcus, & Barnes, 1999). Hartig, Mang, and Evans’ (1991) research indicates that both prolonged and shortened periods of interaction with nature (simulated or actual) are conducive to overall well-being assessed by affective self-reports. A more recent study by Hartig et al. (2003) found a significantly higher overall happiness for subjects after a 40 minutes’ walk through a natural environment compared to those walking through an urban environment. It was also found that positive affect increased in the natural but decreased in the urban environment. Furthermore, feelings of anger and aggressiveness decreased in the natural but increased in the urban setting. Ulrich found in several studies that exposure to slides or tapes of natural environments can increase several aspects of well-being. In 1979, Ulrich

found that the influences of natural scenes (slides) compared to urban scenes (slides) enhanced positive affect including feelings of affection friendliness, playfulness, and elation. This finding was consistent with the result that nature exposure significantly reduced fear arousal. Showing slides of natural environments was beneficial for emotional states, in particular if those environments included water (Ulrich, 1981). Finally, Ulrich et al. (1991) found that compared to subjects exposed to video tapes of urban scenes including traffic or pedestrians, those confronted with natural tapes including vegetation and water experienced higher restorative effects on positive affect, anger, aggression, and fear. Van den Berg, Koole, and Wulp's (2003) findings are in line with Ulrich's (1979, 1981, 1991) and Hartig et al.'s (1991, 2003) findings, as they also found a significant decrease of depression, anger, tension and overall stress and an increase for overall happiness when exposing subjects to slides of park-like forest areas as when letting subjects see slides of streets with shops.

A different approach to investigate the effects of nature on mood is to find out which kind of places people choose if they are in a negative mood state (Regan, & Horn, 2005). In this respect, Francis, and Cooper-Marcus (1991) found that if people were asked where they would like to be when feeling low or depressed, trees, water and plants were mentioned most frequently. Also, Korpela (2003) found that subjects with high negative mood were more likely to choose natural places as their favorite ones than other places. Also, Van den Berg et al.'s study (2003) reports that negative affect is negatively correlated with the perceived beauty of built and positively correlated with natural environments.

Furthermore, Bingley, and Milligan (2004) results show a relationship between outdoor play in natural settings during childhood and mental health and well-being during subsequent young adulthood and long-term positive effects on mental health and well-being in adulthood.

Effects of nature on cognitive functioning

Besides the positive effects of nature on physical health and psychological well-being, it can also benefit cognitive functioning (Hartig et al., 1991).

For instance, Berman, Jonides, and Kaplan (2008) recently found that walking in nature or only viewing it improved directed-attention capabilities and short term memory compared to walking in or viewing urban environments. Tennessen, and Cimprich (1995) investigated the effects of the window view from students' dormitory rooms. The results show that having a more natural view from the window increases objectively measured directed attention when performing the tests in front of the window. Also, the perceived attentional functioning was rated higher by those students having only nature to look out at than those seeing some or only built features. In Van den Berg et al.'s (2003) study, people watching a video of a forest like area performed slightly better in a concentration test than people watching urban environments. Spending leisure time in a garden compared to the favorite place indoors was found to improve the power of concentration in the elderly (Ottosson, & Grahn, 2005).

Natural views from classrooms increase pupils' stimulation, decrease boredom, and are associated with better performance on tasks requiring focus and attention (Eberhard, 2005). Wells (2000) also found positive effects of

nature on the children‘s cognitive functioning. Children moving from urban areas to greener ones were found to have a greater ability to direct their attention than children staying in the same, less natural, area. Activities taking place in green areas were also reported to lessen symptoms in children suffering from Attention Deficit Disorder (Faber Tayler, Kuo, & Sullivan, 2001).

Besides the effects of negative mood on the preference of natural environments (Van den Berg et al., 2003; Korpela, 2003; Francis, & Cooper-Marcus, 1991), the level of mental fatigue has similar effects on environmental perceptions. Staats, Kieviet, and Hartig (2003) findings suggest that highly mentally fatigued subjects have less favorable attitudes towards walking in an urban environment than subjects that feel refreshed and energetic. Natural environments are preferred over urban environments by people who had been instructed to imagine needing to rest directed attention (Herzog, Black, Fountaine, & Knotts, 1997).

For children, Korpela et al. (2002) found that children who identified a natural setting as their favorite place tended to give the need for cognitive restoration and relaxation as a reason to visit the place slightly more often compared to children that had other than natural places as their favorite ones.

Influences of design features

The word nature, in this study, is not only used for naturally grown greenery but also incorporates parks and other green settings that have been designed by humans. The following sections concentrate on the importance of different design aspects in the design of green areas that could be restorative for users.

Schoolyard design principles

Schoolyards are supposed to be safe places for children as they are usually separated from motorized traffic and often supervised by teachers. Therefore a schoolyard has the potential to be a place where children can experience “free movement and play, creativity, discovery and social values” (Sebba, 1986). To fully support these benefits, Sebba (1986) proposes several design principles. A schoolyard should be rich in opportunities, so that pupils can choose from physical, exploratory and social activities. Different activity areas should accommodate varying group sizes and provide possibilities for play, rest, and watch others play. There should be several entrances and exits to inhibit crowding in one place. Contact with nature and greenery in the schoolyard ideally consists of vegetation which changes over the course of the year. Kim (1998) states that natural elements and connection to nature can give physical activity restorative qualities in addition to the benefits of exercise. The growing body of literature about the effects of greening schoolyards was summarized in a meta-analysis by Bell, and Dyment (2008). The benefits of green schoolyards include increased play opportunities, enhanced social relations between pupils and with teachers, heightened environmental concern, increased learning opportunities, and improved academic performance, enhanced physical activity and also health.

Groning (1986) further mentiones the high attractiveness of having a food resource in the schoolyard which was also found by Whyte (1980) who observed behavior in public spaces. As Whyte (1980) notes:”Where there is food, people gather”. Besides those people magnets, a schoolyard and any environment should provide niches, where people can find retreat and privacy (Groning, 1986; Evans, & McCoy, 1998). In terms of retreat, Wachs, and

Gruen (1982) state that spaces where people can briefly get away and be alone may buffer some of the harmful effects of crowding. Crowding means unwanted social interactions which can negatively influence well-being and restoration (Evans, 1979; Evans, 2003; Evans, 2006). Privacy nooks and stimulus shelters can offset some of the stressful impacts of high levels of stimulation (Evans, & McCoy, 1998).

Another important feature of successful schoolyards is the provision of shade (Moogk-Soulis, 2002). Schoolyards are heat islands often built from the hottest materials, like asphalt pavement, chips, tar, and mowed turf.

A few empirical studies have tried to evaluate some of these playground elements. The Boston schoolyard initiative started to renovate several deteriorated schoolyards during the mid 1990s. Lopez, Campbell, and Jennings (2008) took advantage of this natural experience since approximately half of the schoolyards were being changed and the others remaining unrenovated. They found positive effects of these improvements on the standardized test scores of the state mandated math test which was more often passed by students from the renovated schoolyards. In a Chinese study by Tanabe, Mishima, and Fujii (2005) schools offering a lawn in the schoolyard were compared to schools that did not have a lawn. Pupils in the “lawn schools” played, romped and rested more by having a greater variety in these actions than pupils in non-lawn schools. Nevertheless, there was no difference in other activities, like playing volleyball or soccer.

Another study by Fredrizzi, and Flach (2007) included the teachers, students and parents in the design process of the schoolyard. This resulted in a lot more greenery, additional play equipment and an open classroom in the adjacent wood. They found that after the installation of the schoolyard there

was fewer conflicts among the children, as well as children and staff; dropping-out decreased and children enjoyed classes more, finding them more interesting and spending more time studying.

Effects of design participation of users on its acceptance

Since the 1970s architectural programming has become a standard subject in architecture schools. Its' aim is that any built space responds to the behavioral and social needs of the users (Duerk, 1993). To achieve this aim, it is first inevitable to include users in the design process and to optimize communication between designers (experts) and users (lay people) (Dieckmann, & Schuemer, 1998), which has been found to be problematic (Rambow, 2000).

An ideal design process uses at least one of the several existing participatory design approaches, which differ in methodology but which all emphasize the importance of including all or relevant samples of users (Sims, 1978).

From workspace literature we know that the acceptance of changes to the environment is better if the employees had been involved in the design process (Reich, 2004). When people are involved in designing an environment they need to use later, they can identify themselves better with the outcome and thus also like it better (Eisenkolb, & Richter, 2008).

For restorative environments it is important to note that the restorative potential of environments may depend upon people liking the environment (Hartig, & Evans, 1993). This finding suggests the value of using a participatory design approach for restorative environments. This was also included in the present study.

Conclusion and Justification

The literature shows numerous positive effects of physical activity, nature and/or greenery exposure and participatory design on different aspects of humans' perception and functioning. The current study tried to include indicators for all these parameters (well-being, restoration, physical fitness and cognitive functioning, evaluative questions) to obtain a more holistic picture than the former studies which mainly concentrated on one or two dependent variables. The operationalizations of the dependent variables however are based on different, former studies which found them to be sensitive to environmental changes.

Most of the cited studies either used a laboratory setting which limits generalizability or they were case studies lacking a control group which does not allow for a clear understanding of environmental effects. To rule out potential trends and random changes causing differences within the test group over time, the current study employed a control group.

This study further investigated the potential influence of regular exposure to nature/greenery during children's play (exposure to the more natural schoolyard). General health is affected by urbanity. Independent of multiple demographic and socioeconomic characteristics, risk of illness tends to be higher in people living in a highly urban area, with little access to green space (urban green, agricultural green, forests and nature areas), "blue" space (fresh and salt water surface) and having no garden at home (De Vries, Verheij, Groenewegen, & Spreeuwenberg, 2003; Maas, Verheij, Groenewegen, de Vries, & Spreeuwenberg, 2006). We also know that nature exposure has many positive effects on humans' functioning. Therefore, we assume that the improvement in these parameters following nature exposure

might be higher for people who are regularly little exposed to greenery. Those people may have lower initial functioning levels which are more likely to increase than in people who already have a high functioning level. This hypothesis has not been examined so far but may play an important role in the beneficial mechanisms of nature.

METHODS

Hypotheses

H1: The new schoolyard will have positive effects on the test school pupil's psychological, physical and cognitive functioning.

H1a: Pupils of the test school will experience an increase in well-being and restoration (psychological functioning).

H1b: Pupils of the test school will experience a decrease in blood pressure and heart rate (physical functioning).

H1c: Pupils of the test school will experience an increase in attentional capacity (cognitive functioning).

H2: The new schoolyard will be perceived as more restorative and attractive than the old one by pupils and teachers.

H3: Children with less residential exposure to nature/greenery will benefit more from the schoolyard re-design.

Design

This longitudinal quasi-experimental study had a 2x2 design with repeated measurements on one factor.

There were two independent variables (both having two levels):

- Installation of schoolyard: yes/no
- Time: pre and post construction

There was one continuous independent variable:

- Exposure to nature/greenery (operationalized as the view from a home window)

Table 1: Study design

	First measurement (before installation)	Second measurement (after installation)	Complete data sets for both times of measurements
New schoolyard (test group)	100 (97)	100 (83)	100 (72)
No new schoolyard (control group)	80 (76)	80 (79)	80 (61)
	180 (173)	180 (162)	180 (133)

Remark: Numbers in cells represent planned sample sizes. Numbers in parentheses stands for actual sample sizes.

Subjects

A total of 195 pupils of all three schools was tested twice, once before and once after the installation of the schoolyard. From the test school (new schoolyard), 106 pupils were tested. They were all between 13 and 15 years old (52% female). The control group (no new schoolyard) consisted of 89 pupils (all 13-15 years old) from two schools located in the same city. Fourty-six pupils (54% female) came from the “Hauptschule Europa”. The other 41 (44% female) pupils of the control group came from the “Sonnenhauptschule”.

From the 195 pupils, 133 had complete data sets from both test sessions. Those were used for the statistical analyses. From the remaining participants, 72 (49% female) came from the test school and 61 (48% female) from the control schools.

The participants were recruited by talking to the schools’ principals. All of them were willing to have their fourth grade pupils participate in the study.

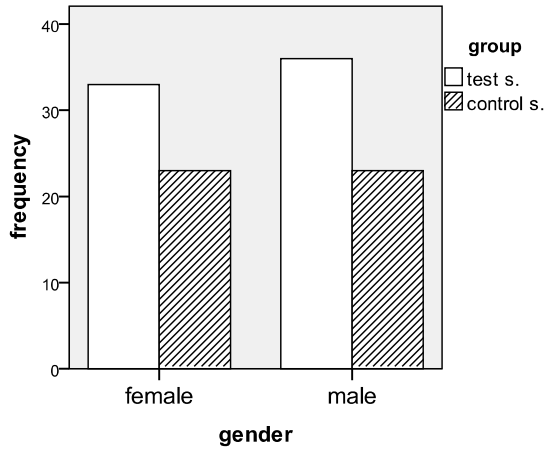
The test school was a Gymnasium (secondary school) which pupils are from 10 to 18 years old. The control schools were both Hauptschulen

(secondary modern school) that have an age range from 10 to 15 years. For this study all fourth grade pupils were chosen which were all between 13 and 15 years old. This selection was based on the assumption that younger pupils would have difficulties in understanding the questionnaires and that older pupils are less likely to use the schoolyard than the younger ones. Furthermore, pupils older than 15 years would not have been available in the control schools.

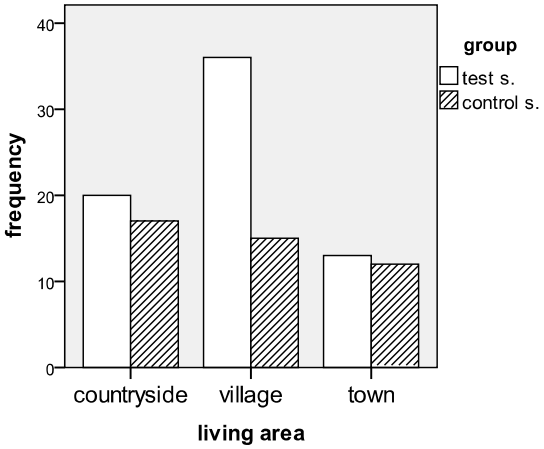
The main difference between the two groups was the school type. Usually a “Gymnasium” is harder than a “Hauptschule”, so that pupils in a “Gymnasium” tend to have higher levels of academic achievements. But as the school of interest is the only “Gymnasium” in this city, the pupils from the “Hauptschule” were the only available control subjects. To see if the groups were still comparable the distribution of potentially moderating demographic variables was compared between the two groups.

Demographic variables

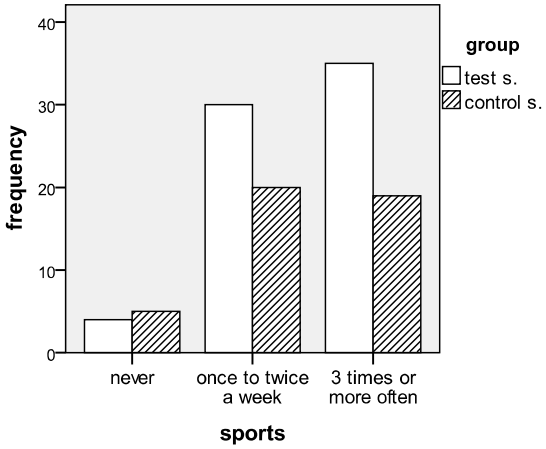
The equality of the two groups in major demographic variables was tested using Chi-square tests and t-tests. Variables included gender, height, weight, living area, frequency of being outdoors, sports activities, and parent’s highest education level. The following graphs 1-8 show the distribution of each variable in the two groups.



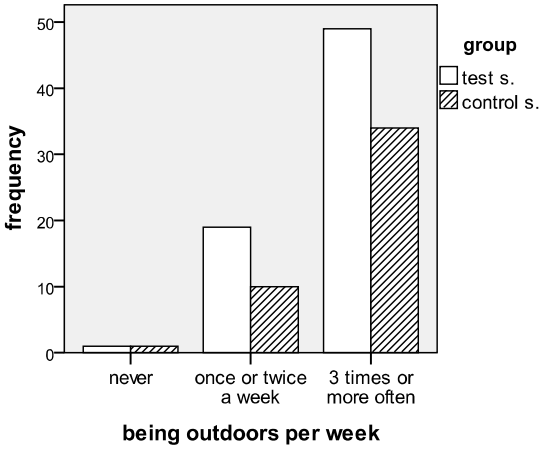
Graph 1: Frequency of males and females in the two groups



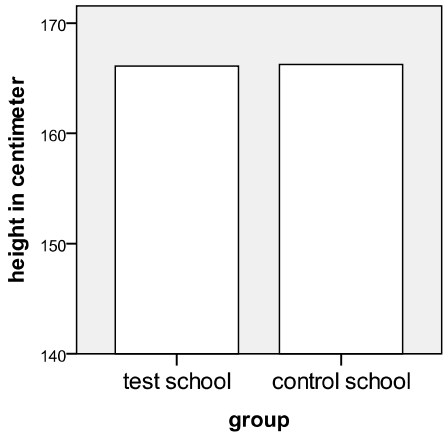
Graph 2: Frequency of pupils living in the countryside, a village, a town in the two groups



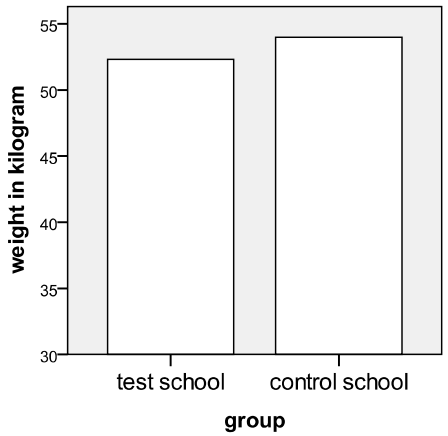
Graph 3: Frequency of sports activity per week in the two groups



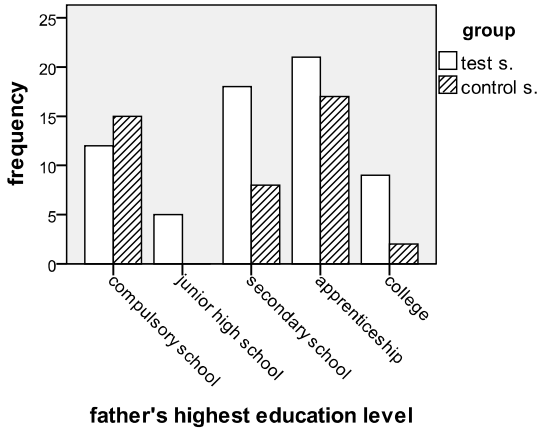
Graph 4 : Frequency of being outdoors per week in the two groups



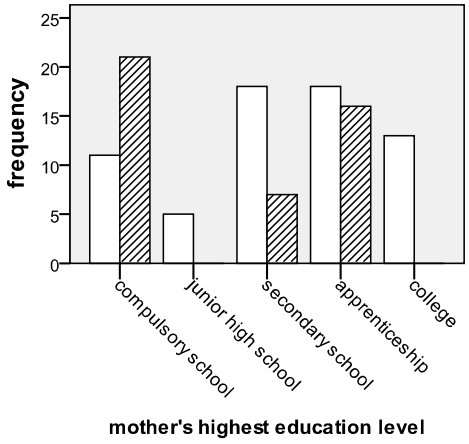
Graph 5: Average height in the two groups



Graph 6: Average weight in the two groups



Graph 7: Frequency of father's highest education in the two groups



Graph 8: Frequency of mother's highest education in the two groups

The chi-square test for gender was not significant ($X^2_{(df = 1)} = .052$, Fisher's exact test: p=.851) indicating that gender distribution was not significantly different between the two groups. Also the distribution of the living area of the pupils did not differ significantly between the test and the control school ($X^2_{(df=2)}=3.574$, p=.167). Neither were there significant differences in the frequency of sportive activity per week ($X^2_{(df=2)}= 1.389$, p=.499) nor in the time spent outdoors ($X^2_{(df=2)}=.472$, p=.792). For height ($t_{(df=128)}=.852$, p=.398)

and weight ($t_{(df=127)}$=.231, p=.818) the t-tests did not show significant differences between the test school and the control schools.

Though, father's highest education level ($X^2_{(df=4)}$=9.553, p=.049) and mother's highest education level ($X^2_{(df=4)}$=22.886, p=.000) were significantly differently distributed in the two groups. Parents tended to be higher educated in the test school group. Therefore, we statistically tested for the influence of mother's and father's highest education on the dependent variables but did not find significant results. In the other demographic variables, the groups did not differ significantly and therefore potential moderating effects of these variables can be precluded. That is why we ran the main analysis without any covariates.

Materials

The materials included unstructured interview questions, standardized questionnaires, a computer test and a blood pressure measurement device.

Unstructured interview questions

To determine which features pupils would like to have and use in their schoolyard, seven questions were sent to each pupil of the test school via email. Those questions asked how often pupils were using the current schoolyard, what they usually do for restoration, what they would like to have and be able to do in the new schoolyard (full version see appendix).

Additionally, socio-demographic variables included parents' educational levels, inhabitants of living area, frequency of sportive activities per week,

amount of time spent outdoors per week, availability of a garden at home, weight, and height (full version see appendix).

Also, evaluative questions about the old and new schoolyard were given to the pupils and the teachers to determine the mainly used features and how satisfied people were with these features (full version see appendix).

To determine the living area of the pupils as rural or urban the size of the home town was requested. But as the school is located in a small town in a rural area there were too few pupils living in a bigger city. Therefore another measure was used to assess pupils' exposure to nature/greenery at home. At the second time of measurement the pupils were asked to draw their view from the window of the room they spend the most time in at their homes. They were asked to label every build feature with "B", every natural feature with "N" and the sky with "S" and had to paint the view in a predefined box that they had to imagine to be their window (full version see appendix).

Standardized Questionnaires

The Basler Befindlichkeitsskala (= Basler wellbeing questionnaire; Hobi, 1985) is a standardized, German questionnaire to assess the current wellbeing state that is divided into four factors. These factors are called bodily and cognitive vitality, social extravertedness and psychological balance. The accumulation of these four factors together makes the overall well-being score (full version see appendix).

The internal consistencies (Cronbach's α) of the Basler wellbing questionnaire are sufficiently high for all four factors (between .81 and .91) as well as for the well-being score (.92). Factorial validity was proven by performing factor analysis with different subsamples which all revealed the

structure of the same four factors. Factor analysis including the Basler wellbeing questionnaire, the scales of the Freiburger Personlichkeitsinventar (FPI, Freiburger Personality Inventory, Fahrenberg, Hampel, & Selg, 1994), and the Beschwerden-Liste (B-L, somatic complaints scale, Zerssen, 1976) revealed an independent “current well-being” factor distinct from the habitual personality dimensions of the other questionnaires. Correlations with objective achievement measures and conceptual similar scales could be found. In respect of these findings, discriminant and criterion validity can be taken as fulfilled.

The Recovery-Stress Questionnaire (Kallus, 1995) was used to determine pupils’ restoration and stress states. It exists in German and English and evaluates the current state of restoration and stress for 12 different fields which are depicted in the following table 2.

Table 2: Scales & Subscales of Recovery-Stress-Questionnaire (Kallus, 1995)

Subscale	**Scale**
General Stress	Stress
Emotional Stress	
Social Stress	
Conflicts	
Fatigue	
Lack of Energy	
Somatic Complaints	
Success	Restoration
Social Restoration	
Physical Restoration	
General Restoration	
Sleep Quality	

The Recovery-Stress-Questionnaire is a behavior based questionnaire which asks how often specific situations have taken place during the last three

days and nights (full version see appendix). In terms of reliability, the internal consistency (Cronbach's α) for all scales and subscales is between .70 and .90 and also the retest reliability of .79 and .91 is sufficiently high. Factor validity was found to be independent of the sample. Criterion correlations with the Eigenschaftswörterliste (adjective scale, Janke, & Debus, 1978) which is a well-being scale were in line with the expectations.

The Perceived Restorativeness Scale (Hartig et al., 1997) determines the subjective impression of the restorative qualities of an environment. This was the only questionnaire that did only exist in English and was therefore translated into German and back translated into English from an independent person. It assesses four scales: Being away, fascination, coherence and compatibility which are all based on the Attention Restoration Theory from Kaplan and Kaplan (1989, full version see appendix).

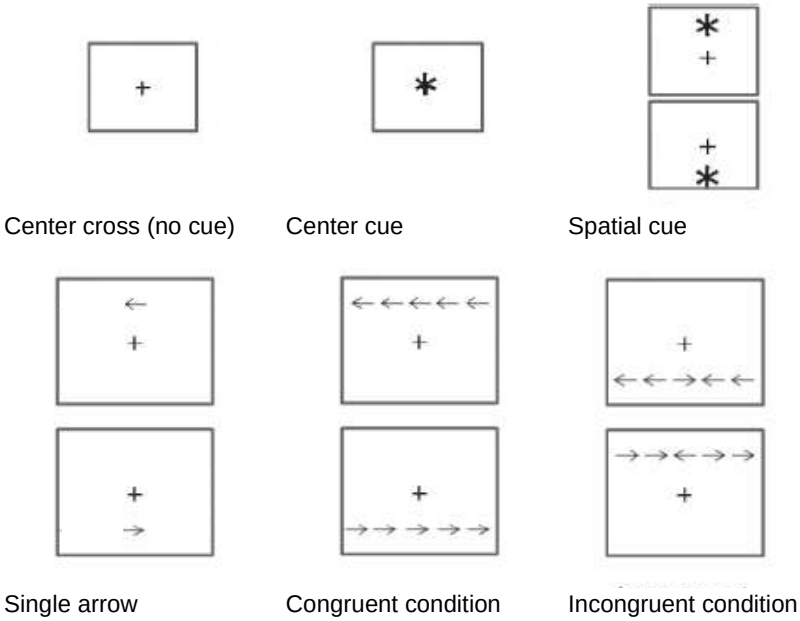
Internal consistency was found to be >.70 for all subscales in different samples (Hartig et al., 1996). Factor analysis (Hartig et al., 1997) revealed the hypothesized four factor solution. Convergent, discriminant and criterion validity coefficients were largely as expected (Hartig et al., 1996).

Computer Test

To determine cognitive functioning the Attention Network Test (ANT; Fan McCandliss, Fossella, Flombaum , & Posner, 2005) was used. The ANT is a computer based reaction time test that measures the efficiency of the attentional networks involved in alerting, orienting and executive attention. In this test subjects have to fix a central cross above or beneath which an arrow is presented and subjects have to press the corresponding arrow key on the keyboard. The test either shows one ore five arrows. If there are five arrows

the subject has to respond to the arrow in the middle (target arrow). The middle arrow either points in the same direction (congruent condition) as the flanking arrows or in the opposite direction (incongruent condition). The intervals between two trials vary between 600 and 3,200 ms and also depend on the subject's response time. Before the presentation of the arrow(s) the subjects randomly get a central, spatial or no cue. The central cue informs the subjects that the next target is approaching. The spatial cue additionally indicates where the arrow is going to appear (above or beneath the central cross). The ANT consists of 96 congruent trials, 96 incongruent trials, 72 spatial-cue trials, 72 center-cue trials, and 72 no-cue trials. There are 72 trials that have a double asterisk cue (appearing at the top and bottom of the display) and 96 trials that have no flanking arrows surrounding the target arrow. In total, there are 288 trials split up into three test phases between which subjects have a break of 30 seconds. Each test phase takes about 5-7 minutes. Before the three trials start the subjects have a 2 minutes practice phase during which the test gives corrective feedback on their responses to ensure that they understood each possibility before starting the test trials.

Alerting attention is calculated by contrasting central-cue trials with no-cue trials. Orienting attention compares spatial-cue trials (if arrow will appear above or beneath center cross) with center-cue trials which do not provide information where the arrow is going to appear. Executive attention compares incongruent (middle arrow has different direction than flanking arrows) with congruent trials (middle arrow aligns with flanking arrows. The following graph 9 shows an example for each condition.



Graph 9: Schematic representation of conditions of the Attention Network Test (Fan et al., 2005)

For all networks (orienting, alerting, and executive) moderate to high reliabilities were found. Validity testing revealed that the three networks are independent and uncorrelated across subjects (Fan, McCandliss, Sommer, Raz, & Posner, 2002).

Measurement device for blood pressure

Blood pressure and heart rate were measured with blood pressure measurement devices from BOSO (medistar-S, see http://www.boso.de/Blutdruckmessgeraete-fuer-Patien.16.0.html and appendix for sample picture). These can easily be used individually and are mounted around the wrist of one's non-dominant hand. Subjects only have to press the start button and wait for the values (systolic and diastolic blood pressure, and heart rate) to settle. The device stores thirty readings.

To receive reliable measures of blood pressures, at least six readings of systolic blood pressure are needed, and six to ten diastolic blood pressure readings are required (Llabre et al., 2007).

Site description

The “Gymnaisum” in which the new schoolyard was built is located in Gleisdorf, a city with approximately 5.000 inhabitants in Austria. The schoolyard that was to be redesigned is approximately 1128 square meters (=12142 square foot) big, having 24 meters (79 feet) on the short side and 47 meters (154 feet) on the long side. The schoolyard is surrounded by the school building like a courtyard.

The following pictures (graph 10) provide an impression of the appearance of the initial schoolyard.

Graph 10: Old schoolyard from different perspectives.

The pictures show that the existing schoolyard did not provide a lot of green landscape apart from two trees and a lawn which covers only a small part of the whole area. The only seating options available were two heavy park benches. As the only sporting opportunities there were three table tennis tables but neither balls nor rackets to play table tennis were offered.

The two controls schools are both located in the same street. The “Sonnenhauptschule” (graph 11) provides an outdoor area for their pupils offering some seating options on a lawn interspersed with trees and shrubs. Compared to the test school, this outdoor area is not enclosed by the school building.

The “Eruopahauptschule” (graph 12) does have a real schoolyard but some pupils spend breaks outdoors at the entrance area which also offers some trees and benches to sit on. But it is not designated to be a schoolyard.

Graph 11: Schoolyard at Sonnenhauptschule

Graph 12: Outdoor area at Europahauptschule

Procedure

In winter 2008, first meetings were held with the Gymnasium's principal to ensure that the school was willing and able to build a new schoolyard over the course of the following summer semester. It was further discussed which pupils would be useful to have as participants. According to the principal's experience the schoolyard had mainly been used by pupils from the first to the fourth grade. In agreement with the principal, the fourth grade pupils were chosen which were thought to have least troubles in understanding the questionnaires.

After having received the consent of the Gymnasium's principal to participate, the control schools' principals were asked to have their fourth grade pupils as a control group. Both of them were willing to send all their fourth grade pupils to the two test sessions. The parental consent forms were sent to the principals of all schools who then handed those to the pupils.

In January 2009 the email with the seven questions was sent to all 800 test school pupils asking for their opinions about the existing schoolyard and what changes they would like to have accomplished. The email was sent from the Gymnasium to the pupils and the school forwarded it to the experimenter. This was done due to the fact that the school was not allowed to pass on the pupils' email addresses. The overall response rate was 11.6 % (93 emails out of 800 sent ones).The reason for this pretty low rate could be that a lot of pupils do not use their school's assigned email address. Another reason may be that pupils did not have an interest in the schoolyard.

The information from the emails was systematically collected and a quantitative analysis of contents was performed. The results were then, as far as possible, implemented in the new schoolyard design. Additionally, cost

estimations for the installation of each feature were provided. The plans and costs were then discussed with the school's principal, an architect, the student council president and some individual pupils. The plans were modified according to the inputs and some financial restrictions.

From the 16th to the 19th of March the first data collection (baseline) was performed. The pupils were measured in groups of 20 in a computer room that the Gymnasium allocated. The complete test session lasted for approximately 50 minutes which matches the duration of one lesson between two breaks. There were always two test conductors present to help the children with questions. The pupils from the control schools also came to the same computer room in the Gymnasium to take the test session.

After the pupils had entered the room and found a place the test instructor explained them the reason for the study and what they would have to do during the test session. Pupils were asked to read and sign the child consent and to turn in the parental permission forms (see appendix). Only two parents did not want to have their children participate in the study. All pupils that had come to the test sessions were willing to participate.

Afterwards the handling of the blood pressure measurement device was explained and the pupils had to put the devices around their wrists of their non-dominant arm. Then the first test measurement was taken. The pupils therefore only had to push the start button, wait for the values to settle and finally write them down in a predefined table (see appendix). The pupils kept the measure device around their wrist for the whole test session and took each measure following the test instructor's announcements. In an interval of five minutes the blood pressure and heart rate were taken seven times during one test session.

After the first blood pressure measurement, pupils started to fill out the demographic questions and the questionnaires. The demographic section also included questions about their residence, the size of the village or city they lived in, the view from their main window, if they had a garden at home and how much time they usually spend outside in the nature. Then the Basler Well-being Questionnaire (Hobi, 1985), the Recovery-Stress Questionniare (Kallus et al., 1995) were completed by all pupils. The pupils from the test school had to additionally fill out the Perceived Restorativness Scale (Hartig et al., 1997) in light of their existing schoolyard. Every five minutes the instructor told them to measure the blood pressure again. When all pupils were done filling out the questionnaires, the computer test was explained. Then the pupils had a practice trial that took about two minutes, during which they got corrective feedback. After the test trial another blood pressure and heart rate measurement was taken and eventual questions about the test were answered. Then the three test trials started of which takes about five minutes each. During the break in between these trials, pupils again measured their blood pressure and heart rate. At the end of the computer test, the last blood pressure and heart rate measurement were taken and pupils were asked to stay seated and quiet till every pupil had finished the computer test.

Finally the pupils were thanked for their participation and promised to get a monetary reward if they would attend the second test session as well.

During the end of April and the beginning of May 2009 the new schoolyard was installed. A volleyball net and soccer goals were built. One of the existing trees was replanted and integrated in the new shrubs border of a privacy nook. Ten flexible seating groups (tables with a bench and two chairs), three sitting chests and 30 sitting pillows were placed in the schoolyard. At

one of the two entrances a drinking fountain was installed. Additional plants were added by putting pot plants from inside the school out in the schoolyard (see pictures in the results section).

During the first and the second test session some frequency analyses were performed to see if the two groups were comparable in demographic variables and in the dependent variables. The groups turned out to be comparable; the only problem that was found was that it was not reasonable to split the pupils up in two groups according to their residential area as most of them were from rural areas. Therefore another measure for exposure to nature/greenery had to be found. This new measure was defined as the view from the home window of the room where people spend the most time in. Pupils had to draw this view according to their memories. To validate this method, eight different kids of the same age group were given the same task and pictures were taken from their actual window view. The ratio of greenery to built environment and sky was compared between the paintings and the pictures and was highly correlated ($r=.566$, $p= .144$).

The second test period was then performed between the 23rd of June and the 6th of July, so that the pupils from the test school had an exposure time to the new schoolyard of at least one month.

The second test session followed the same procedure as the first one but included some new questions about the pupils' usage and opinions about the new schoolyard. Also, the drawing of the window view from home was added. After the second test session the class representative got 40€ for the whole class as a reward for their participation.

Statistical Analyses

Pre-study correlations

The validation of the paintings of the window view was done by correlating the resulting amount of greenery, built features and sky in the paintings with the amount of these factors in the pictures. Therefore, the areas of each of the three categories (nature, built, sky) had to be determined. The paintings were scanned and the paintings and the pictures were imported to ArchiCad 12 where the contours of each feature were redrawn. The program then automatically calculated the sum of the areas of each category (nature, built, sky). The same was done for the pictures but from an independent person.

The ratio used to determine the greenness of the view was calculated with the following equation.

Percentage of built features = $A_{built}*100 /(A_{built}+A_{nature}+A_{sky})$

Percentage of nature = $A_{nature}*100 /(A_{nature}+A_{built}+ A_{sky})$

Ratio between built features and nature= (- Percentage of built features) +Percentage of nature

The resulting numbers varied between -100 (only built features in view) and +100 (only nature in view).

A Pearson correlation was performed between the ratios from the paintings and the pictures. The correlation coefficient was .566 with p=.144. Though the correlation was not significant it was pretty high considering the small sample of only eight people. The same ratio was calculated for the participants of the main study.

Analysis of contents for main study

To analyze the data from the emails a quantitative analysis of contents was performed. Therefore, the answers to the question “What would you like to have in your schoolyard?” were sorted and identical or very similar answers were put together. The frequencies of same answers were calculated and finally the resulting compromised list of answers was split up in categories of overarching themes. The higher the frequencies of a category the more importance was given to it in the design of the new schoolyard.

Statistical analysis for main study

First, the data’s normal distribution and homogeneity of variances were tested. Most of the data fulfilled the assumptions. For exceptions, normal distributions were achieved by performing transformations. Finally, parametric analyses could be performed for all variables. No missing values were replaced; subjects with missing data were excluded from the analyses.

The effects of the schoolyard on well-being, restoration and cognitive functioning were analyzed using analyses of variance with two factors and repeated measures on one of these factors (2x2). For the dependent variable physical fitness, planned comparisons were used as this indicator is best established to be sensitive to physical activity enhancement and nature exposure. To evaluate the effects of the exposure to greenery, multiple regressions were performed. Changes in perceived quality of restorativeness and other evaluative questions were tested using t-tests with repeated measures.

RESULTS

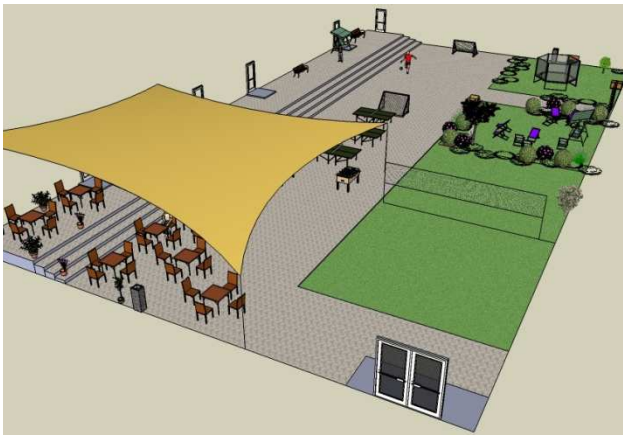
First, the results are shown for the pre-study that was done to analyze what pupils like to have in their schoolyard. A quantitative content analysis was performed which results constituted the basis for the new schoolyard design. See the following table 3 for the results grouped in categories.

Table 3: Results of quantitative content analysis

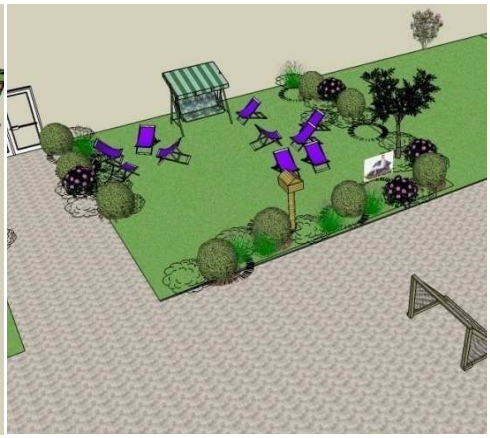
	F
More greenery	**46**
More plants (shrubs, flowers)	15
More trees	10
More grass	9
Less concrete	7
More colors	5
Seating options	**65**
Benches	19
Tables and chairs	13
Comfy chairs (deck chairs)	12
More seating option	8
Hammocks	7
Swings	6
Shade	**4**
Sun roofs	4
Sports	**36**
Volleyball net	6
Table tennis tables	6
Soccer goal	6
Basketball	4
Trampoline	3
Miniramp	3
Soccer tables	3
Jump rope	2
Darts	1
Paintball	1
Pool	1
Refreshments	**8**
Vending machine	4
Drink water fountain	4

As the table shows, there were three predominant categories. Pupils wanted to have more greenery, like plants, trees and grass; a variety of seating options, like benches and chairs and more comfortable seating, like deck chairs; and sporting facilities and equipment, like a volleyball net, soccer goals and table tennis tables. Some mentioned they would like to have sun protection and refreshment features.

Based on the frequency and the feasibility of the desires a design plan was developed, which is shown in the following pictures.



Graph 13: Plan of new schoolyard



Graph 14: Privacy nook

Graph 15: Aerial perspective of schoolyard

Graph 16: Seating area

The available budget did not allow for major changes, like new surface materials or completely restructuring the existing layout. Furthermore, it had to be considered that all features needed to be flexible and removable as the schoolyard is often used for events like theatre performances or anniversary feasts.

The major goals were to provide more greenery, sporting options and a variety of seating opportunities being flexible and cost efficient.

More greenery was planned in the lawn area. Rows of seasonal shrubs that change over the course of the year were planned to function as a border for a privacy nook (see graph 14). The corner where the trampoline was planned for was also intended to be surrounded by shrubs which could then function as a second privacy nook as well (see graph 15). Finally, the café like seating area under the awning should be interspersed by several pot plants (see graph 16). The plants were chosen to provide a variety in colors and blooming period.

As sporting options, the existing table tennis tables, soccer goals, a volleyball net, two foosball tables, a trampoline and a box with additional small sports equipments like jump ropes, balls, and rackets were planned to be installed.

The variety of seating options was thought to include a café like area with tables and chairs (graph 16) to offer an area to take a snack or to study. More comfy chairs like deckchairs and seating pillows for the privacy nook (graph 14) and some benches and garden swings aligned along the schoolyards borders were planned as well. Seating was intended for relaxation and should all be lightweight to allow for arranging it to adjust to different group sizes.

Additionally, it was planned to install an awning that would partly cover the café area to provide sunny and shady places. Furthermore, a vending machine and a drinking fountain should offer refreshments.

The original plan was then modified in response to feedback from the school’s principal, student council president and some pupils. A few changes had to be done due to further financial restrictions and safety and

maintenance concerns. The following pictures (graph 17-19) show the new schoolyard.

Graph 17: New schoolyard

Graph 18: Privacy nook

Graph 19: Sporting options of new schoolyard

Most but not all the proposed changes were performed. Instead of greenery borders around the privacy nook and the trampoline area, only one row of shrubs was planted along one side of the privacy nook (graph 18).

The sporting features were all installed except for the foosball tables which were too expensive and the trampoline was thought to be too dangerous. From the proposed seating opportunities, the deck chairs and

garden swings were rejected due to safety concerns. The awing came out to be too expensive but may still be installed if the money becomes available. The vending machine was said to be unnecessary because there is a buffet inside the school building and it would cost too much maintenance to refill it and put it inside during winter months.

Results of main study

The main results are organized in terms of the hypotheses (well-being, restoration, physical fitness, and cognitive achievements, evaluation outcomes).

Well-being (hypothesis 1a: psychological functioning)

The well-being measure was the BBS (Hobi, 1985) which calculates an overall well-being score and four subscales: bodily and cognitive vitality, social extravertedness, psychological balance.

Overall the well-being of the pupils decreased from the first measurement in spring (beginning of summer term) to the second measurement at the end of the school year ($F_{(1,131)}$=5.327; p=.023). Also, the cognitive vitality ($F_{(1,131)}$=12.756; p=.000) and social extravertedness ($F_{(1,131)}$=8.941; p=.003) showed a significant decrease from the first to the second time of measurement. Bodily vitality showed a trend in the same direction ($F_{(1,131)}$=3.379; p=.057). No significant chances over time were found for psychological balance ($F_{(1,131)}$=2.386; p=.125).

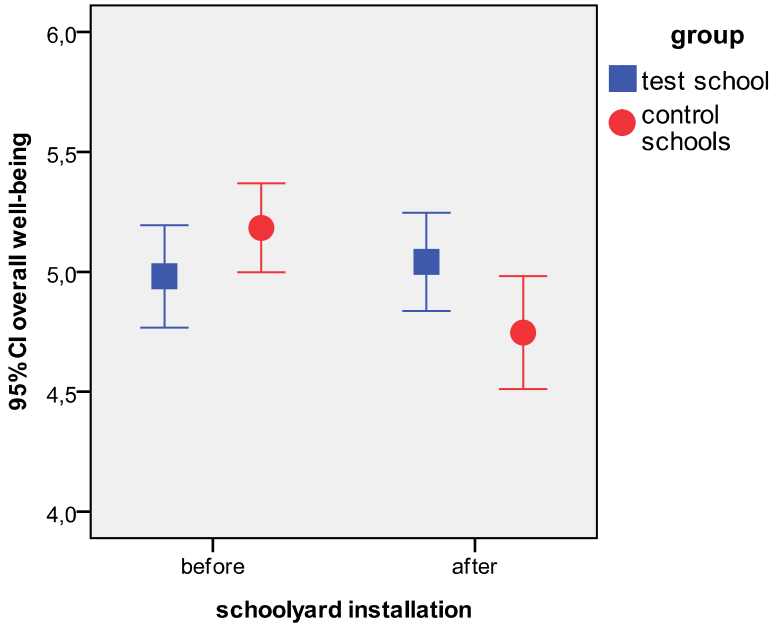
The interaction between time of measurement (before and after installation of schoolyard) and group (control vs. test school) was significant for all well-being scores. While all well-being scores decreased for the pupils

from the control schools, the values of the test school either increased or stayed on the same level. The overall well-being increased test school pupils but decreased for control school pupils ($F_{(1,131)}$=5.327; p=.003), (table 4 and graph 20).

Table 4: Descriptive Statistics of overall well-being

	N	*M*	*SD*
Before installation			
Test school	72	4,9812	,90825
Control schools	61	5,1834	,72609
After installation			
Test school	72	5,0411	,87036
Control schools	61	4,7462	,91837

Remarks: N...sample size M....mean SD... standard deviation



Graph 20: Interaction of time of measurement and group for well-being

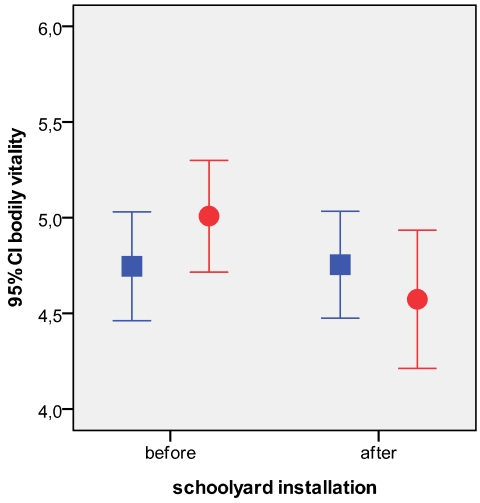
Psychological balance increased in pupils from the test school while it decreased in pupils from the control school ($F_{(1,131)}$ = 5.488, p=.021). Bodily vitality ($F_{(1,131)}$ =3.964, p=.049) and social extravertedness ($F_{(1,131)}$ =7.909;

p=.006) both stayed on the same level for test school pupils but decreased for control school pupils. Cognitive vitality decreased for both groups but significantly more for the control school than for the test school ($F_{(1,131)}$=4.716; p=.032). For all four subscales the mean values and standard deviations are shown in the table 5. Also see graph 21-24 for an illustration of the results.

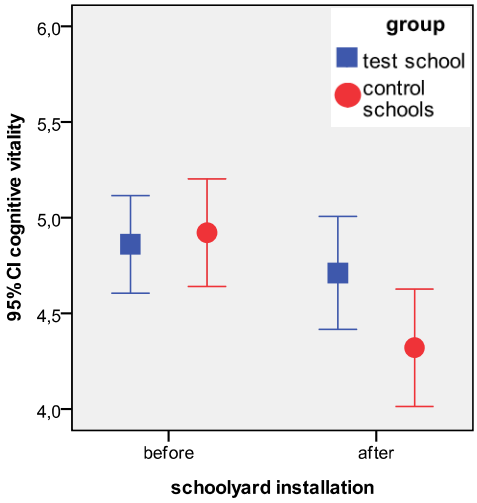
Table 5: Descriptive Statistics of all well-being scales

	Before installation			After installation		
	N	Mean	SD	N	Mean	SD
Bodily Vitality						
Test school	72	4.7465	1.21210	72	4.7546	1.19163
Control schools	61	5.0250	1.13934	61	4.5625	1.41842
Cognitive Vitality						
Test school	72	4.8611	1.08356	72	4.7118	1.25503
Control schools	61	4.9222	1.08663	61	4.3097	1.20411
Social Extravertedness						
Test school	72	5.1157	1.27188	72	5.0972	1.19900
Control schools	61	5.4042	1.00959	61	4.8000	1.13270
Psychological Balance						
Test school	72	5.2014	1.00932	72	5.6007	.87980
Control schools	61	5.3778	1.00358	61	5.2958	1.15209

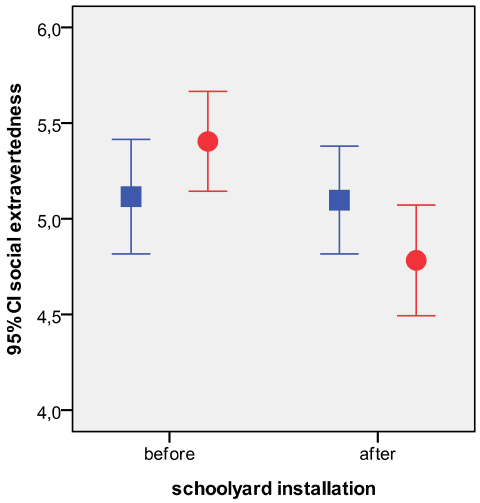
Remarks: N...sample size M....mean SD... standard deviation



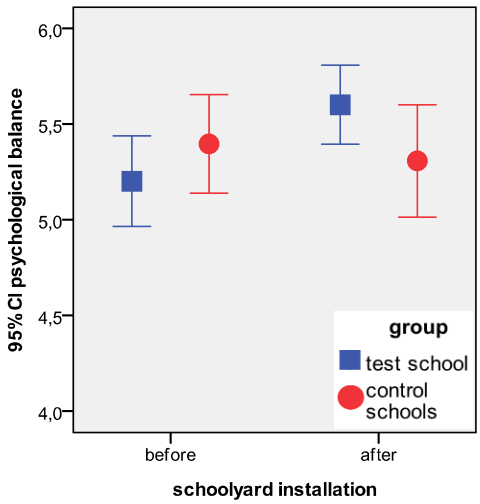
Graph 21: Interaction of time and group for bodily vitality



Graph 22: Interaction of time and group for cognitive vitality



Graph 23: Interaction of time of measurement and group for social extravertedness



Graph 24: Interaction of time of measurement and group for psychological balance

Restoration and Stress (hypothesis 1a: psychological functioning)

The questionnaire that was used to measure restoration has several scales which are summed up to two major scales; one indicating stress and one indicating restoration state.

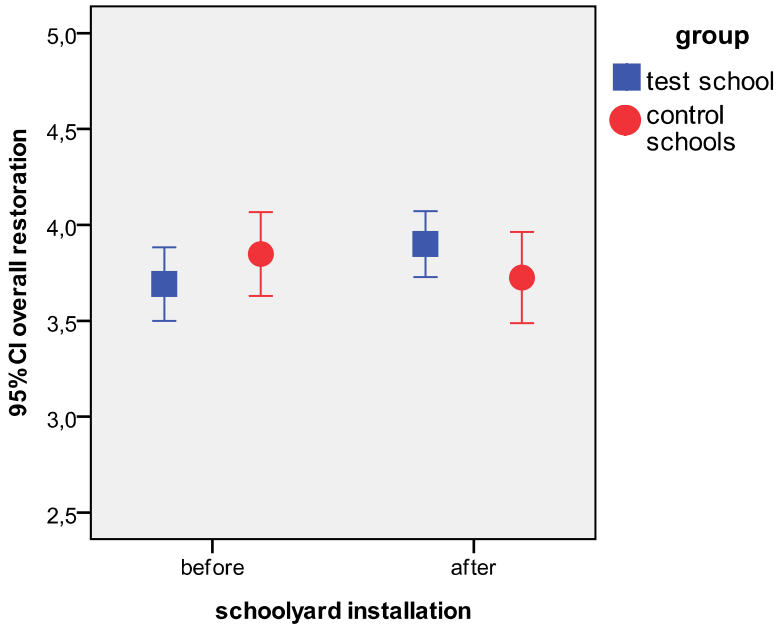
Over time there were no significant changes for the major scales restoration ($F_{(1,128)}$=.157; p=.692) and stress ($F_{(1,128)}$=.445; p=.506).

But the interaction between time (before and after installation of schoolyard) and group (test vs. control school) was significant for the restoration scale ($F_{(1,128)}$=5.492; p=.021). Restoration increased for pupils from the test school but decreased for pupils from the control schools (see table 6 and graph 25). No significant difference between the two schools was found for the overall stress score ($F_{(1,128)}$=.266;p= .607, see table 6). Neither were there any significant differences in the stress related subscales.

Table 6: Descriptive Statistics of restoration and stress main scores

	Before installation			After installation		
	N	Mean	SD	N	Mean	SD
Restoration						
Test school	73	3,6918	,82323	73	3,9000	,73805
Control schools	52	3,8567	,81076	52	3,7088	,88847
Stress						
Test school	73	1,8415	,76998	73	1,7387	,94403
Control schools	52	1,8302	,84919	52	1,8170	1,05834

Remarks: N...sample size M....mean SD... standard deviation



Graph 25: Interaction of time of measurement and group for restoration

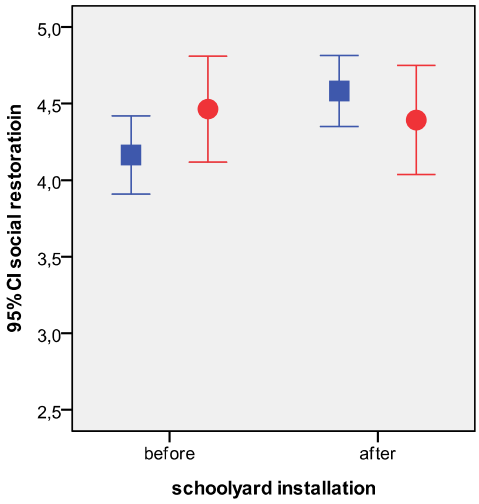
For two of the five restoration subscales there were significant differences between the two schools over time. Social ($F_{(1,127)}$=4.561; p=.035) and general ($F_{(1,127)}$=5.796; p=.017) restoration increased from the measurement before the installation of the schoolyard to the measurement after the installation for the test school pupils but decreased during the same

time for the control schools pupils (see table 7 and graph 26-28). The same trend was found for physical restoration ($F_{(1,127)}$=2.782; p=.098).

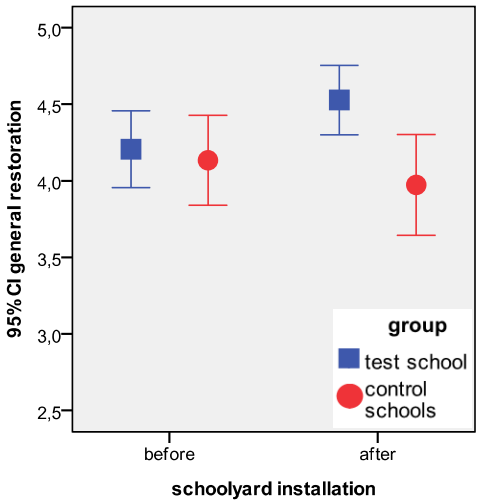
Table 7: Descriptive Statistics of the significant restoration subscales

	Before installation			After installation		
	N	Mean	SD	N	Mean	SD
Social restoration						
Test school	73	4,2055	1,07637	73	4,5822	,99308
Control schools	56	4,1339	1,09333	56	4,3929	1,33046
General restoration						
Test school	73	4.8611	1.08356	73	4.7118	1.25503
Control schools	56	4.9222	1.08663	56	4.3097	1.20411
Somatic restoration						
Test school	73	3,2055	1,24954	73	3,3699	1,02749
Control schools	56	3,3214	1,21890	56	3,1250	1,16872

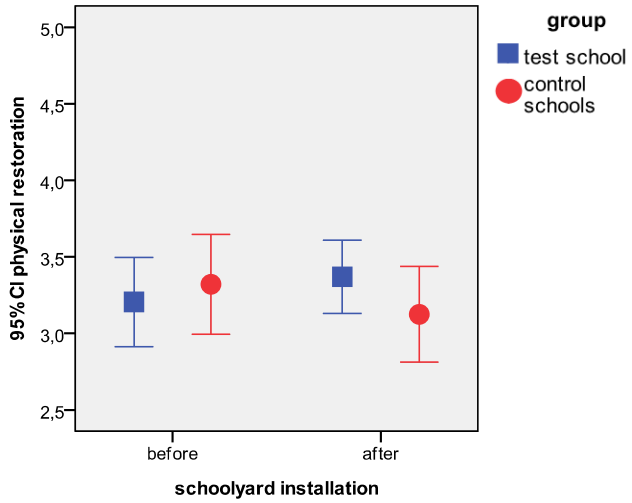
Remarks: N...sample size M....mean SD... standard deviation



Graph 26: Interaction of time of measurement and group for social restoration



Graph 27: Interaction of time of measurement and group for general restoration



Graph 28: Interaction of time of measurement and group for physical restoration

There were no significant results for the success ($F_{(1,127)}$=.200; p=.655) and sleep quality ($F_{(1,127)}$=443; p=.507) scores.

Blood pressure and heart rate (hypothesis 1b: physical functioning)

Physical fitness was measured with blood pressure and heart rate. Both indicators were measured seven times during the test sessions. For statistical analyses, only the second through the seventh reading were used, as the first reading is usually not valid. It takes at least six values to receive a reliable value (Llabre et al., 2007). Within those values, systolic blood pressure values below 70 and above 200mmHg and diastolic blood pressure values below 40 and above 120mmHg were excluded. For heart rate, values between 40 and 130 were accepted.

As statistical analyses, planned comparisons were used that contrasted the test school's pupils mean of the second measurement (after schoolyard

installation) with the mean of the other three means (both measurements of control school's pupils and first measurement of test school's pupils).

Significant effects were found for diastolic blood pressure ($F_{(1,184.3)}$= 15.464; p=.000) and systolic blood pressure ($F_{(1,175.4)}$=5.136; p=.025). A slight trend in the same direction was found for heart rate ($F_{(1,161.6)}$=2.639; p=.106). See the following table 8 for the means and standard deviations.

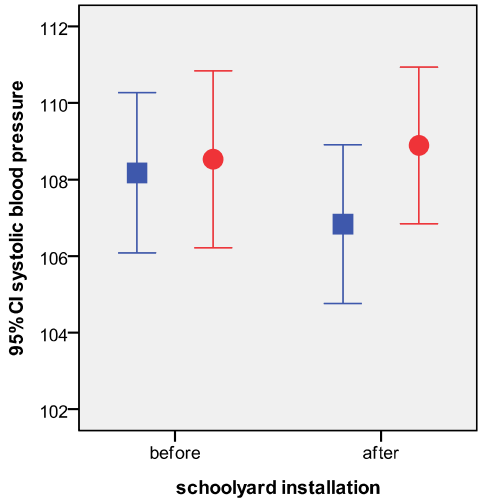
Table 8: Descriptive Statistics of the physical fitness indicators

	Test school at second time of measurement			Mean of both times of control school's measurements and test school's first time of measurement		
	N	Mean	SD	N	Mean	SD
Diastolic BP	75	62.67	8.25	201	65.88	7.85
Systolic BP	75	106.21	8.93	201	108.34	9.05
Heart rate	75	80.94	10.32	201	83.74	10.82

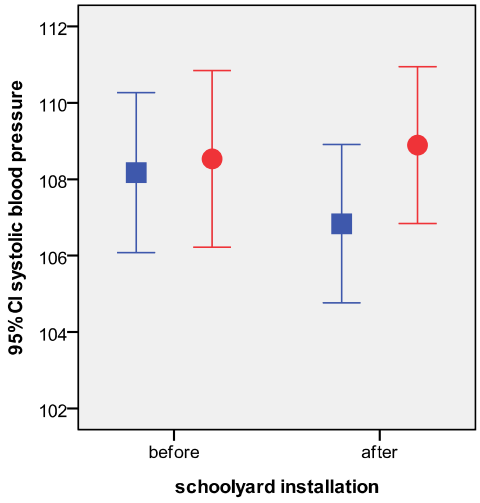
Remarks: N...sample size M...mean SD...standard deviation

As can be seen from the table, the mean values of all three physical fitness indicators were lower for the test school's pupils at the second time of measurement compared to the mean of both times of the control school's measurements and test school's first time of measurement.

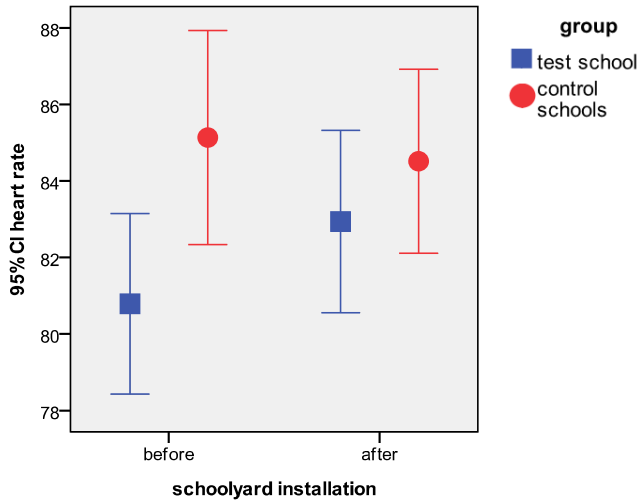
The graphs 29-31 illustrate the findings for all physical measurements.



Graph 29: Change in diastolic blood pressure from first to second measurement in both groups



Graph 30: Change of systolic blood pressure from first to second measurement in both groups



Graph 31: Change of heart rate from first to second measurement in both groups

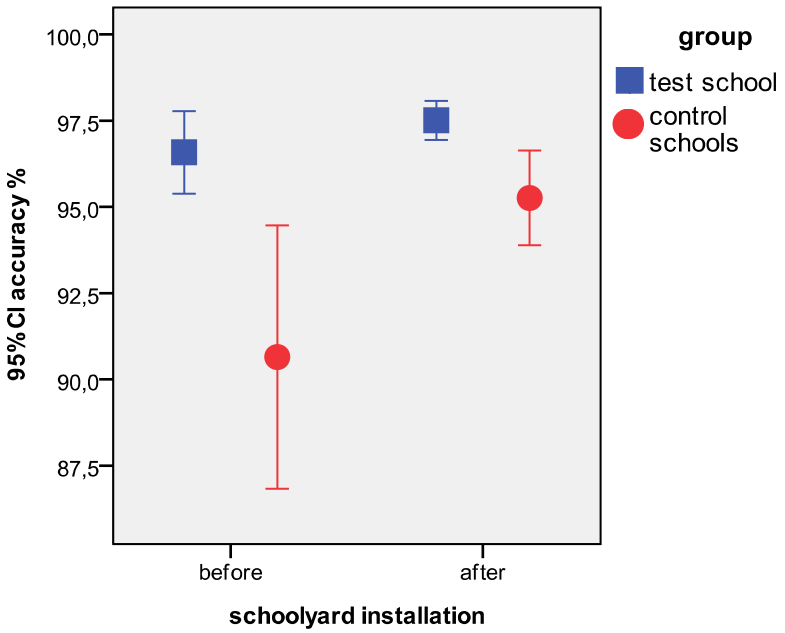
Attention (hypothesis 1c: cognitive functioning)

To determine the potential influence of the new schoolyard on the cognitive functioning of the pupils, the Attention Network Test (ANT, Fan et al., 2005) was used. For the statistical analysis 24 out of 126 pupils had to be excluded as they did not finish the test nor had more than 70% accuracy which was taken as an indicator that they had not taken the test seriously. For the scales alerting ($F_{(1,100)}$=.400; p=.528), orienting ($F_{(1,100)}$=.067; p=.796) and executive control ($F_{(1,100)}$=1.404; p=.239) no significant interaction was found. The only significant effect was found for accuracy ($F_{(1,100)}$=7.135; p=.009). Pupils from the control school had an increase of the accuracy from the first to the second measurement, while pupils from the test school stayed on the same level (see table 9 and graph 32).

Table 9: Descriptive Statistics of the accuracy from the ANT

	Before installation			After installation		
	N	Mean	SD	N	Mean	SD
Accuracy						
Test school	61	97,0656	2,79207	61	96,9672	2,79861
Control schools	41	92,0000	9,35949	41	95,5122	4,47282

Remarks: N...sample size M....mean SD... standard deviation



Graph 32: Interaction of time of measurement and group for accuracy %

Evaluation Outcomes (hypothesis 2: perceived restorativeness and attractiveness by pupils and teachers)

Evaluation measures were taken from all pupils from the first to the fourth grade and from teachers of the test school. Though the PRS (Hartig et al.,1997) was only given to the main sample (fourth grade pupils) at both measurement times. At the first time of measurement the pupils had to think of their current schoolyard to answer the items. The second time, when the new schoolyard had already been installed, the items had to be answered in light of the new one.

Pupils' Evaluation

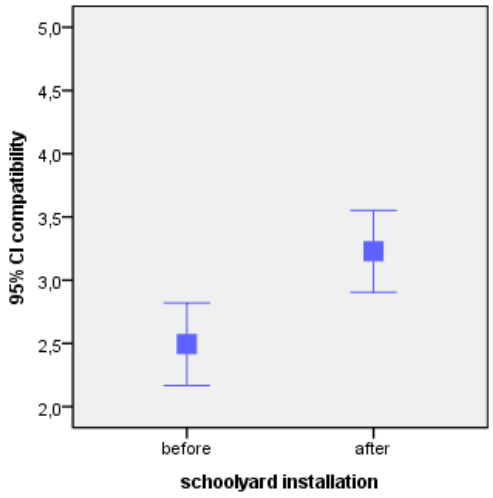
There was a significant improvement in the subscale compatibility ($T_{(62)}$=3.864; p=.000; see table 10 and graph 33). Pupils of the test school felt more compatible with the new schoolyard than with the old one. Another

significant result was found for coherence ($T_{(62)}$=2.291; p=.025) but in the direction that pupils found the new schoolyard was less coherent than the old one (see table 10 and graph 34). A trend for improvement was also found in the scale of fascination ($T_{(72)}$=1.778; p=.080), so that pupils found the new schoolyard more fascinating than the old one (see table 10 and graph 35). The only scale that showed no significant differences for the old and the new schoolyard was being away ($T_{(72)}$=.1.218; p=.227).

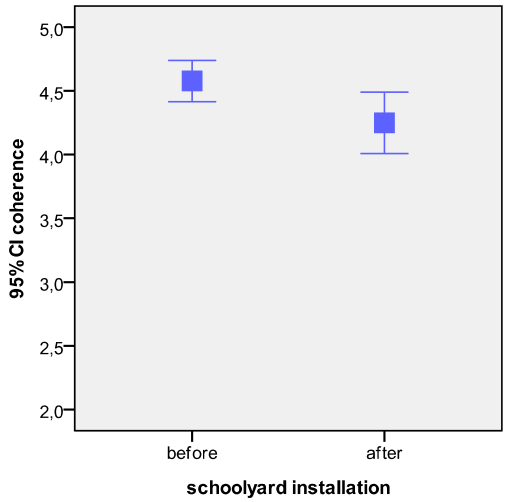
Table 10: Descriptive Statistics of the PRS

	Before installation			After installation		
	N	Mean	SD	N	Mean	SD
Compatibility	73	2,4730	1,30770	73	3,0952	1,30846
Coherence	73	4,5714	,64824	73	4,2302	1,00131
Fascination	73	2,9558	1,49537	73	3,3085	1,41066

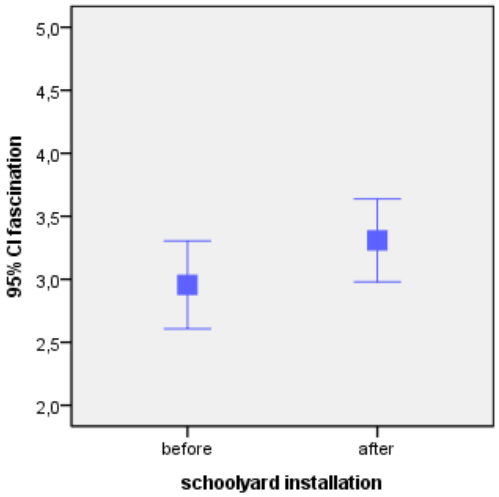
Remarks: N...sample size M....mean SD... standard deviation



Graph 33: Interaction of time of measurement and group for compatibility



Graph 34: Interaction of time of measurement and group for coherence



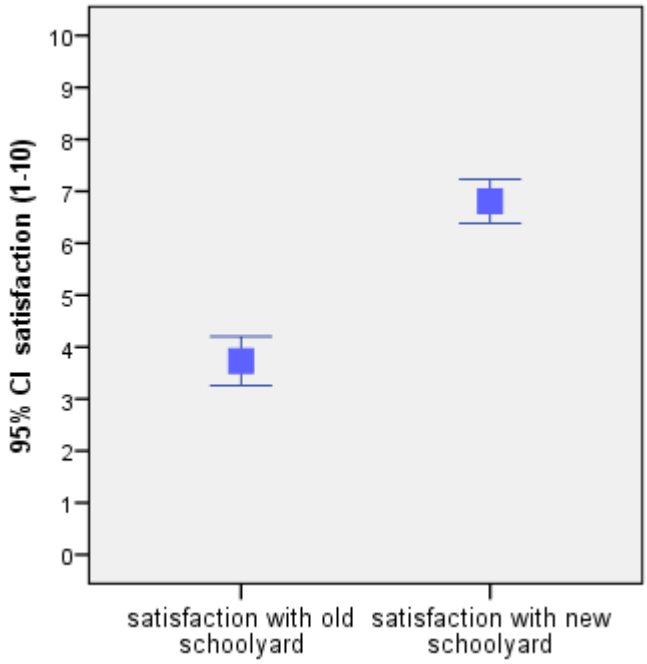
Graph 35: Interaction of time of measurement and group for fascination

Aside from the PRS a self constructed questionnaire was used to evaluate the new schoolyard. All these questions were only asked at the second time of measurement. Pupils from the main sample (fourth grade) were significantly more satisfied with the new schoolyard (rated on a 10-point scale from 1 to 10) than with the old one ($T_{(78)}$=10.016; p=.000), (see table 11 and graph 36).

Table 11: Descriptive Statistics of Satisfaction in pupils of main sample

	With old schoolyard			With new schoolyard		
	N	Mean	SD	N	Mean	SD
Satisfaction	79	3,81	2,196	79	6,85	1,902

Remarks: N...sample size M....mean SD... standard deviation



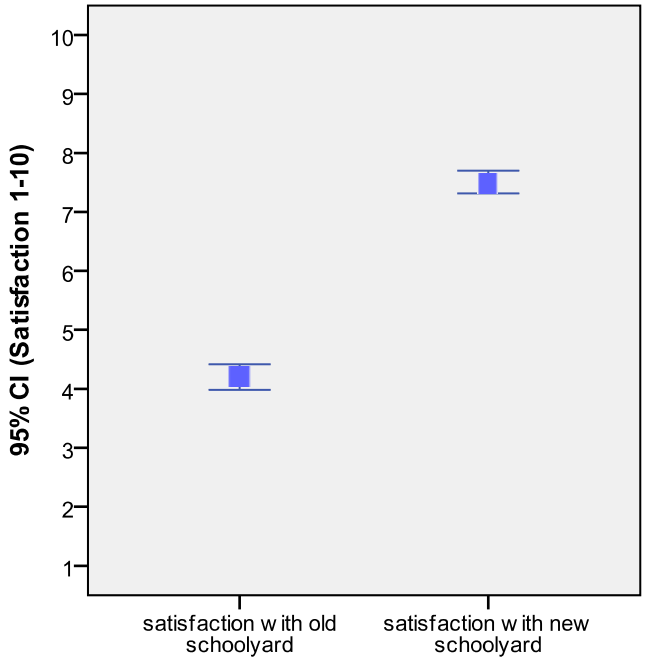
Graph 36: Satisfaction with old and new schoolyard in main sample (4th grade)

Additionally to the pupils from the main sample (fourth grade), the pupils from the first to the third grade were given the evaluation questionnaire. These were also significantly more satisfied with the new schoolyard than with the old one ($T_{(377)}$=24.221; p=.000).

Table 12: Descriptive Statistics of Satisfaction in pupils from 1st to 3rd grade

	With old schoolyard			With new schoolyard		
	N	Mean	SD	N	Mean	SD
Satisfaction	378	4.02	2.14	378	7.51	1.92

Remarks: N...sample size M....mean SD... standard deviation



Graph 37: Satisfaction with old and new schoolyard in pupils from 1st to 3rd grade

For the following results, the samples were combined. Pupils were asked if the frequency of visiting the schoolyard had changed since the reconstruction. Most pupils (f=254, 55.2%) stated they were using the schoolyard as often as before. 161 pupils (35%) said that they were spending more time in the schoolyard than they had done before. Only 45 (9.8%) were now going there less often.

We also asked the pupils what they had already done in the schoolyard since its reconstruction.

The following table 13 shows the frequencies and percentages with which each of the activities had been performed.

Table 13: Frequencies and percentages of activities done in the schoolyard

Activity	**Frequency**	**Percentage**
Watching others	249	53.8
Sitting on a bench	224	48.4
Sitting at tables next to entrance	190	41.0
Eating a snack	187	40.4
Sitting on a seating pillow	180	38.9
Playing soccer	151	32.6
Drinking from the fountain	129	27.9
Playing table tennis	127	27.4
Playing volleyball	126	27.2
Sitting on a chest	82	17.7
Splashing with the fountain	77	16.6
Sitting at a table in privacy nook	72	15.6
Battling with the pillows	49	10.6
Studying	34	7.3

As can be seen from table 13, the activity most pupils had done so far was watching others, followed by sitting on a bench, sitting at the tables next to the entrance, eating a snack and sitting on a seating pillow, which are all passive activities. The next popular activities being done with percentages ranging from 32.6% to 27.2% are physically active and include playing soccer, playing table tennis and playing volleyball. Also, 27.9% had already been drinking from the fountain.

Activities fewer than 20% of the pupils had performed include sitting on a chest, splashing with the fountain, sitting at a table in the privacy nook, battling with the sitting pillows, or studying.

After asking pupils what they had done and used, they were also asked how satisfied they were with each of the features on a 10 point scale, ranging from 1 to 10. In the following table 14 the mean and standard deviation of each feature is shown.

Table 14: Descriptive statistics of satisfaction with each feature

	N	mean	sd
Seating pillows	442	7.80	2.54
Drinking fountain	441	7.70	2.54
Seating groups	442	7.45	2.56
Additional shrubs	442	7.29	2.57
Table tennis tables	442	7.12	2.47
Volleyball field	441	7.01	2.75
Soccer goals	442	6.65	3.01

Table 14 shows that overall pupils were pretty satisfied with the new features. They were most content with the seating pillows and last content with the soccer goals.

They were also asked what they like most and least about the new schoolyard, which reasons there are to not use the schoolyard and which further improvements they could think of. These questions were open ended. Therefore, quantitative content analyses were performed for each question which results are depicted in the following tables 15, 16, 17, and 18.

Table 15: What do you like best about the new schoolyard?

Sports features	
Soccer goals	46
Table tennis tables	36
Volleyball net	32
Volleyball field	29
Soccer field	28
Variety of activity options	21
Variety of sporting options	10

Seating features	
Seating pillows	50
Seating options	24
Benches	24
Tables	9
Chairs	7
Chests	3

Natural features	
Drinking fountain	47
Plants	6
Trees	4
Greenery	3
Shrubs	2

Activities	
Play Soccer	32
Play Volleyball	28
Relax	8
Snap fresh air	3
Have a snack	3
Talk	3
Watch others	1

Attributes	
More beautiful	7
Good design	6
Nicer	5
Less empty/grey	2
More vivid	1

Other	
Nothing	11
Was never there	5
Everything	3

Table 15 shows that the new sports facilities were most popular. Answers did not only include the mentioning of the facility as such but also the activity afforded by it. The new soccer goals (46) and field (28) and the new volleyball net (32) and field (29) were highly appreciated by the pupils. Also, the table tennis tables were referred to as the favorite feature pretty often (36). More general answers referring to sporting elements were that pupils liked the big variety of activity (21) and sporting options (10) a lot.

Following sports, seating features were identified to be highly liked. Besides pointing out specific examples, like the seating pillows (50) and the benches (24), pupils more generally mentioned “seating options” (24). The tables (9), chairs (7) and chests (3) were mentioned less often.

The third category of favorite objects contained the natural improvements. The drinking fountain (47) was mentioned most often. Plants (6), trees (4), greenery (3) and shrubs (2) were referred to less often.

In terms of activities, sportive activities like playing soccer (32) and volleyball (28) were more often preferred than relaxing (8), snapping fresh air (3), having a snack outside (3), talking (3) or watching others (1).

A few pupils answered by mentioning attributes like “more beautiful” (7), “good design” (6), “nicer” (5), “less empty” (2), and “more vivid” (1).

A small number of pupils said they did not like anything about the new schoolyard (11), had not been there yet (5) or liked everything best (3).

To the question about things pupils do not like about the schoolyard, the answers turned out to be a lot less homogenous. The categories and frequencies are shown in table 16.

Table 16: Is there anything you do not like about the new schoolyard? If yes, what is it?

Objections against equipment and related activities	
Soccer	
soccer players need too much space	8
field too small	8
bad balls	3
goals too small	1
Volleyball	
net (not tight enough)	7
field	2
Table tennis	
tables too old	2
take too much space	1
Drinking fountain	
one gets splashed	2
water too warm	1
everybody drinks from it	1
to close to soccer field	1

Missing	
balls	7
basketball basket	6
too little green	5
deck chairs	2
animals	2
clock	1
colors	1
shadow	1
trampoline	1
rackets	1
out lines at volleyball field	1

Social	
too many people	7
too few people	1
older ones do not let us play	1
others see me	1
pillow battle	1

No Objections	
No	38
Nothing	28
Everything is ok/good/ great	29

Extreme Objections	
It is boring	4
Schoolyard/prison yard	4
A lot	1

Dirt	
wet lawn	9
get dirty easily	2

Time	
no time	2
breaks too short	1

Other	
was never there	6
noise	5
need to put shoes on	3
too small	3
too much shadow	1

The answers that were given most often indicated that pupils did not dislike anything (“No”: 38 and “Nothing”: 28) about the schoolyard but liked

everything (29). In contrast to that only a few pupils mentioned very negative perceptions, saying that the new schoolyard was boring (4), that it looked like a prison yard (4) and that they did not like anything (1).

Aside from these general answers, pupils also indicated specific things they did not like about the new features. The soccer players were said to take too much space (8) but the field was also identified as too small (8). The ball was mentioned to be bad (3) and the goals too small (1).

A few pupils noted that the volleyball net was not tight enough (7) and that they did not like the volleyball field (2). The table tennis table were rated as too old (2) and to take too much space (1).

Some objections existed against the drinking fountain, namely that pupils do not like it because they get splashed (2), because the water is too warm (1), because everybody drinks from it (1) and because it is too close to the soccer field (1).

Besides stating what they do not like about the existing features, a lot of people used the question to say what they still miss. They do not like it that they do not have enough balls (7), that there was no basketball basket (6) and that there is still too little greenery (6). Less often they mentioned to miss deck chairs (2), animals (2), a clock (1), colors (1), shade (1), a trampoline (1), rackets (1), and out markings for the volleyball field (1).

Not only features but also other people and social aspects were disliked. Most people said that there were too many people (7), and single persons stated that there were too few people, that the older ones would not let them play, that they could be seen by others and that people make pillow battles.

Some kids said that they did not like the fact that they get wet when going outside (9) and to get dirty easily (2).

Another aspect was time. Pupils were stating that they did not like the fact that they did not have enough time (2) or that the breaks were too short (1).

Singular answers also were that they had never been there (6), noise (5), that they had to put their shoes on (3), that the yard was too small (3), and that there was too much shadow (1).

Table 17 shows the results of the quantitative analysis for the question about reasons that hinder pupils from visiting the schoolyard.

Table 17: What are reasons not to go into the schoolyard during breaks?

Atmospheric influences	
cold	75
weather	20
rain	10
wet	10
dirt	7
snow	5
winter	2
storm	1

Crowding	
too many kids	14
it is too full	13
noise	3
hectic	1

Time	
too little time	66
breaks too short	40

Interest	
like it better in classroom	21
do not feel like it	13
like it better to be inside	4
boring	3
do not like VB nor soccer	1
do not do sports	1

Table 17 (continued):

Social	
my friends stay inside	13
too many young kids	6
do not like to be watched	6
Soccer takes too much room	5
the older kids	5
boys	2
kids that I do not like	1
People splash with fountain	1

Features	
no balls	5
Schoolyard is too small	3
VB occupied	2
soccer occupied	2
too few pillows	1
no parasols	1
too little lawn	1

Obligations	
prepare next class	8
study	5
change classroom	5
eat/buy snack	3
do homework	2

Other	
change	31
long way	4
do not know when it rings	4
don‘t like new schoolyard	3
I freeze easily	1

The reasons not to go out into the schoolyard that was mentioned most often were climatic aspects like too cold (75), the weather (20), rain (10), wetness (10), dirt (7), snow (5), winter (2) and storm (1).

The next important factor that keeps pupils from using the schoolyard during breaks is time. They say that they had too little time (66), and that the breaks are too short (40).

Also, a lot of pupils are not interested in the schoolyard and visiting it. They prefer to stay in the classroom (21), they do not feel like it (13) or like it better inside (4). Some pupils think that the schoolyard is boring (3), they do not like soccer or volleyball (1) or do not do any sports at all (1).

Further, crowding was given as a reason to stay inside. Pupils said that there were too many kids in the schoolyard (14), that it was too full (13), that it was too loud there (3), and to hectic (1).

Social reasons contained the facts that friends stay inside (13), that there are too many young kids (6), and that pupils dislike it to be watched by others (6). The soccer players are said to take too much room (5). For younger kids, the older kids (5) can be a reason to stay inside. Sporadically, boys (2), children that I do not like (1) and people splashing with fountain (1) were mentioned.

The occupation of schoolyard features can be a reason to stay away from it. Some features do not meet the needs of the pupils or do not exist. The complaints in this category contain the unavailability of balls (5), the small size of the schoolyard (3), the permanent occupation of the soccer (2) and volleyball field (2). Parasols (1) are said to be missing, there are too few seating pillows (1), and too little lawn (1).

A lot of pupils do not visit the schoolyard because they have other things to do during breaks, like preparing for next class (8), studying (5), changing the classroom (5), buying and eating a snack (3) and doing homework (2).

Another important impeding reason is that pupils have to change their shoes before entering the schoolyard which they say they dislike and which costs a lot of time (31). Additionally some mentioned that the way from their classroom to the schoolyard is too long (4).

Some pupils just do not like the new schoolyard (3) and one pupil mentioned freezing too easily to go outside (1).

Finally, things pupils still miss are summarized in table 18.

Table 18: Is there still something you miss in the new schoolyard? What is it?

Additional Features

Sports	
basketball basket	39
balls	29
trampoline	27
pool	20
slide	8
foosball	6
rackets	6
billiard table	5
land hockey	4
skateboard ramp	4
jungle gym	4
carousel	3
moonwalk	3
miniature golf	2
badminton field	1
handball goal	1

Better/More options	
better balls	9
bigger soccer goals	7
out line	7
more space	5
better table tennis tables	5
bigger soccer field	4
sand on volleyball field	2
more options	2
bigger volleyball field	1
more seating options	1
more pillows	1

Seating	
deck chairs	15
Swing	9
Couch	4
beanbag	3
parasols	2
blankets	1

Food	
vending machine	9
Bar	7

Entertainment	
Radio	9
computer	5
television	5

Social	
separation betw. boys and girls	7
separation betw. young and old	4
quiet place	4
more people	2
separations betw. sport and relax	2

Time	
longer breaks	6
Clock	1

Other	
clean floor	2
old schoolyard	2
smoker's area	1
fewer things	1

Nature	
animals	7
colors	7
trees	6
more green	5
lawn	4
flowers	3
less concrete	3
pond	2
fountain	1
shrubs	1

Shade	
sunroof	10
parasols	2

The main category of missing things turned out to be additional sports elements. A lot of pupils are missing a basketball basket (39), additional balls (29), a trampoline (27) and a pool (20). Several children also mentioned to miss a slide (8), foosball tables (6), rackets to play table tennis or badminton (6) and billiard tables (5). Less often pupils still wished a land hockey field (4), a skateboard ramp (4), a jungle gym (4), a carousel (3) and a moonwalk (3). Sporadically notions contained miniature golf (2), a badminton field (1) and a handball goal (1).

Children also wanted more and different seating opportunities. It was said to miss deck chairs (15), swings (9), couches (4), beanbags (3) and blankets (1).

Some pupils also said to miss a greater variety of greenery. They miss animals (7), colors (7), more trees (6), more green (5) and lawn (4), flowers (3), and less concrete (3). A few pupils also mentioned to miss a pond (2), a fountain (1) and more shrubs (1).

Besides wanting a greater variety of sports elements, seating options and greenery pupils regret the absence of some completely different things. Pupils missed the option to get food in the schoolyard like from a vending machine (9) or a bar (7). Some miss technical entertainment equipment like a radio (9), television screens (5), and computers (5). Also, sun protection was missed by several children. They miss a sunroof (10), and parasols (2).

Some pupils used the question to mention what they would like to have improved of the existing things, mainly the sports options. They want things to be better, bigger or a greater number of them. They wanted better balls (9), out markings for the volleyball field (7), better table tennis tables (5) and sand

on the volleyball field (2). The soccer goals (7) should be bigger as well as the soccer field (4), and the volleyball field (1).

Finally, some children needed more space (5), more options (2) and more seating options (1), especially more seating pillows (1).

In terms of social interaction, pupils wished a separation between boys and girls (7), between young and old (4), and between sports and relaxing areas (2). Some pupils desired a quieter place (4) while others wanted to have more people in the schoolyard (2).

Again the lack of time was mentioned in this section. Pupils wanted longer breaks (6) and a clock (1) to know when they need to go back.

There were some more singular answers to what the miss like a clean floor (2), the old schoolyard (2), a smoker's area (1) and fewer things (1).

Teachers' Evaluation

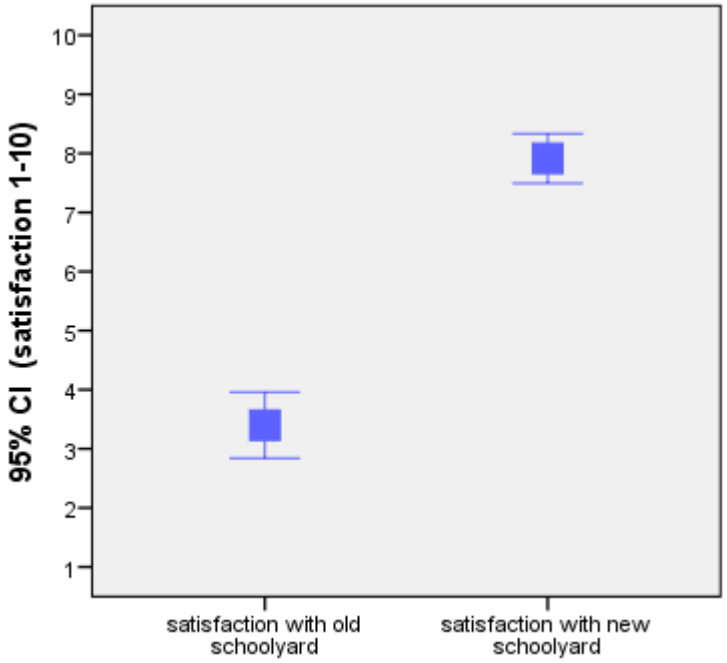
To evaluate the new schoolyard from a second perspective, the teachers were asked to give their opinion on the new schoolyard as well. Thirty-six teachers completed the evaluation questionnaire, from which 21 were female and 15 were male. The mean age of the teacher sample was 47 years, the youngest teacher was 25 and the oldest was 59 years old. On average they had been teaching at school for 16 years, ranging from 1 to 37 years.

Satisfaction with the new schoolyard and the old schoolyard was questioned on a scale from 1-10. A t-test for repeated measures was performed which was statistically significant ($T_{(34)}$= 12.13; p=.000). The teachers were more satisfied with the new schoolyard than with the old one (graph 38). The means and standard deviations are listed in table 19.

Table 19: Descriptive statistics of satisfaction of teachers

	With old schoolyard			With new schoolyard		
	N	Mean	SD	N	Mean	SD
Satisfaction	35	3.40	1,68	9	7.91	1,22

Remarks: N...sample size M....mean SD... standard deviation



Graph 38: Satisfaction with old and new schoolyard in teachers

Asking the teachers if they thought that pupils were using the new schoolyard more often than the old one on a scale from 1 – 10, the mean value turned out to be 8.1, with the lowest value being 6 and the highest being 10.

If pupils use the schoolyard differently than before the reconstruction, 27 (73%) teachers said yes they do and only 1 (3%) teacher meant that they did not use it differently. All teachers who thought that pupils used it differently

said that the pupils were more physically active, that the sports opportunities were used a lot and that there were more pupils out there than before the reconstruction.

Teachers themselves were using the schoolyard rarely during recess times. Twenty-one (68%) of them had never spent time in the schoolyard when having a break. At least 8 (26%) had spent more leisure time in the schoolyard since the reconstruction. Only 2 (6%) had also used the schoolyard during breaks before. The main reasons for the little usage were said to be too little time (5), and having to do work that cannot be done outside (6). Other reasons were that it had not occurred to them to go out there (1), that they had a garden at home (1) and that it was too loud (1). Teachers that spent time in the schoolyard during their breaks, mainly do reading and preparing upcoming lessons (4), playing with the pupils (2), or enjoying the sun (1). To hold lessons, 10 (29%) teachers said that they had done it since the reconstruction, but not before then. Fourteen (40%) teachers had also used the schoolyard for lessons before the reconstruction. Eleven (31%) teachers had never held a lesson outside. Those who had never held a lesson outdoors said that this was because it would be too loud for the classes inside the building (5), that there is no technical equipment (2) and that the subjects (math, computer science) they teach cannot be taught outside (2).

Asking the teachers if they had seen other teacher using the schoolyard to hold lessons, 16 (53%) answered that they had seen other teacher using it more frequently since the reconstruction. Four (11%) meant they had never seen another teacher holding a lesson in the schoolyard and 9 (25%) had the opinion that teachers used it as often as before the reconstruction.

In terms of further improvements 11 teachers would desire some kind of sun roof to cover parts of the schoolyard. Five teachers said that still more greenery would be needed. One teacher thought that additional seating options would be good.

Exposure to Greenery (hypothesis 3: effects of regular nature exposure)

The third main hypothesis was that pupils that are exposed to nature less often than others may benefit more from an increase of natural elements in the schoolyard. Exposure to nature was operationalized with the view from the home window. On the basis of drawings from the children a greenness score was calculated (see methods for detailed explanation). Multiple regressions with three independent variables were used for statistical analysis. The independent variables included the dummy variable “group” (new versus no new schoolyard), the continuous variable “exposure to greenery”, and the multiplication of “group x exposure to greenery” (interaction term). The dependent variables were the same as in all the other calculations.

The grand means of all dependent and independent variables were calculated. The method of forced entry was used. See the following table 20 for the statistical parameters.

Table 20: Regression of diastolic blood pressure onto group, greenness ratio and group x greenness ratio

	B	SE B	β	t	p	df
Well-being	-.001	.004	-.061	-.205	.838	119
Bodily Vitality	-.000	.006	-.002	-.007	.994	119
Cognitive Vitality	-.005	.006	-.262	-.868	.387	119
Social Extravert.	.000	.005	.017	.057	.995	119
Psych. Balance	.001	.005	.058	.193	.848	119
Overall Restoration	.000	.004	-.027	-.083	.934	98
Social restoration	-.006	.007	-.301	-.946	.347	98
Success	.006	.008	.251	.784	.435	98
Physical Restoration	-.003	.006	-.177	-.555	.580	98
General Restoration	.002	.006	.123	.389.	.698	98
Sleep	-.001	.009	-.039	-.120	.904	98
Overall Stress	.004	.005	.217	.679	.499	98
General Stress	.001	.008	.055	.171	.864	98
Emotional Stress	.006	.007	.270	.854	.395	98
Social Stress	-.006	.009	-.222	-.698	.487	98
Conflicts	.005	.008	.188	.585	.560	98
Fatigue	.004	.005	.244	.781	.437	98
Lack of Energy	-.005	.007	-.248	-.770	.443	98
Physical Stress	.004	.006	.201	.625	.534	.98
Systolic blood pressure	-.037	.037	-.294	-1.003	.318	124
Diastolic blood pressure	-.040	.035	-.335	-1.151	-252	124
Heart rate	-.011	.038	-.087	-.296	.768	124
Alerting Attention	-.066	.135	-.155	-.491	.625	103
Orienting Attention	-.096	.133	-.226	-.720	.473	103
Executive Control	.055	.182	.096	.304	.762	103

Remarks: B...unstandardized coefficient β…standardized coefficient SE… standard error t…T-value p…significance level df…degrees of freedom

As can be seen from table 20, for the interaction factor (greenness x group) that was of main interest, no significant influence on any of the dependent variables was found.

DISCUSSION

The main aims of the study were to improve and evaluate the design of an existing schoolyard by incorporating pupils who were using the schoolyard. The potential positive effects of the new schoolyard design on the pupils as well as its appreciation by pupils and teachers were evaluated. The potential positive effects were measured by multiple methods including psychological, physical, and cognitive measures.

Well-being and restoration (hypothesis 1a: psychological functioning)

Our first hypothesis was that test school pupils' well-being and restoration should increase from the first to the second time of measurement compared to the control school pupils.

From the first time of measurement in March to the second time of measurement in June overall well-being decreased for all pupils. This result may be explained with the fact that the second time of measurement was close to the end of the school year where pupils face a lot of final exams and higher workloads than they might have had at the first time of measurement. The initial measurement wave was at the beginning of the semester when exams and major assignments were far away.

Still this result has to be looked at more closely as the interaction between group and time was significant as well. It turns out that overall well-being only decreased in the control school pupils but stayed the same or slightly increased for the test school. Looking closer at the subscales similar patterns could be observed. Control school pupils' bodily vitality and social extraversion clearly decreased while the values of the test school pupils stayed on the same level. Only psychological balance did not decrease for

control school pupils but increased markedly for test school pupils. Cognitive vitality decreased for both schools, but less so for the test school. The fact that cognitive vitality decreased the most and in both school supports our assumption that pupils had higher mental workloads at the second time of measurement and therefore felt less cognitively resilient.

Assuming that pupils in both schools experienced a similar increase of workload from the beginning to the end of the semester these results support hypothesis 1a, saying that the schoolyard has positive effects on the pupils wellbeing. Even though most of the examined pupils did not say that they would use the schoolyard more often, there are still two optional ways how the schoolyard could have positively influenced the pupils. On the one hand, pupils may have benefited more from the schoolyard when spending time there. On the other hand, observations have shown that overall a lot more pupils are using the schoolyard then before which may positively influence the climate in the school building by decreasing noise and crowding inside. As noise and crowding are known to negatively affect mood and well-being (Evans, 2006; Evans, 2003), pupils may have benefitted from decreased noise and crowding. These observations are supported by data from the evaluation questionnaire, where pupils of the main sample said that when they avoided the schoolyard the reason was typically because of annoyance by many younger children out there. So, it is likely that they can restore more during breaks since so many younger children spend the breaks outside and therefore feel better.

For restoration it is interesting to mention that there were no main effects of time on restoration or stress. Regarding the well-being results, a decrease in restoration and an increase in stress would have been expected.

An explanation for the incongruence of the results could be the varying conceptualizations of the questionnaires. While the wellbeing questionnaire asks for feelings, the recovery-stress questionnaire is behavior based and asks for activities and situations that had happened. It may therefore be that some aspects that can negatively affect wellbeing are not contained in the recovery-stress questionnaire. Another explanation could be the time of reference the items are asked for. While the wellbeing questionnaire asks about current wellbeing, the restoration questionnaire asks about actions and situations that had happened during the last three days. If the decrease in wellbeing was mainly caused by heightened workload at school, pupils may have been more influenced by that when answering the wellbeing questionnaire because it was performed in the school building. When thinking about things that had happened during the last three days they may have also thought of situations not happening in school.

Though no main effect was significant, the interaction showed that compared to the decrease in the control school pupils' restoration, pupils from the test school had an increase in the overall restoration score from the first to the second measurement. In particular, the test school pupils had improvements in social, physical and general restoration.

The increase in social restoration can have two plausible reasons. First, the finding suggests that those pupils who often used the schoolyard benefitted from the many new options for interactive play that they did not have before. Secondly, pupils who spent their breaks inside may again have profited from the less crowded environment. Literature shows that crowding can have particularly negative social consequences on children and adolescents (Aiello, Nicosia, & Thompson, 1979).

The enhancement in general restoration which examines being optimistic and being in a good mood aligns with the results from the subscale “psychological balance” from the wellbeing questionnaire. The psychological balance scale assesses feeling secure, non anxious, balanced and non nervous.

Finally, the increase in physical restoration in the test school pupils compared to the decrease in the control school not only supports hypothesis 1a but also supports hypothesis 1b stating that pupils from the test school will have increased physical functioning.

Overall, the findings support hypothesis 1a that the new schoolyard has a positive effect on pupils’ psychological wellbeing and their restoration state.

Blood pressure and heart rate (hypothesis 1b: physical functioning)

Hypothesis 1b was that pupils from the test school should experience a decrease in blood pressure and heart rate over time while control school pupils’ blood pressure and heart rate should not change significantly.

Hypothesis 1b was supported by a significant decrease of diastolic and systolic blood pressure in the test school pupils. For heart rate the same tendency was found. The significant results in the physical parameters are a powerful indication for a positive impact of the changed school environment on pupils from the test school because the sample was young and healthy. To induce a significant decrease in blood pressure is easier to achieve in people with hypertension than in a normative sample (Fagard, 1995).

One of the major options to decrease blood pressure is physical activity (Warburton et al., 2006; Sallis et al., 2000). School environments can encourage physical activity by offering multiple opportunities to exercise

(Sallis et al., 2001; Zask et al., 2001; Sallis et al., 2003; McKenzie et al., 2000; Verstraete et al., 2006). The findings from this study are therefore comparable with the physical activity literature, as the new schoolyard offers a lot more options to be physically active. The decrease in blood pressure may therefore be explained by enhanced physical activity during breaks afforded by the new schoolyard equipment.

For pupils that had not used the schoolyard more often than before, reduced crowding inside the building can again function as an explanation. Crowding has been found to increase blood pressure (Evans, 1979). Assuming that the inverse is true as well (reduced crowding leads to reduced blood pressure), pupils inside may have profited from the less crowded environment.

Attention (hypothesis 1c: cognitive functioning)

The hypothesis was that pupils' cognitive functioning should profit from the installation of the new schoolyard.

Though, the results do not support hypothesis 1c. There were no significant interactions of time of measurement and group in the main scales of the attention network test which we used to determine cognitive functioning.

This test had been chosen because a study by Berman et al. (2008) had found a difference in the scales of the ANT (Fan et al., 2005) comparing people looking at pictures of nature and people looking at urban pictures. It is important to note that the difference between the amounts of nature between the two conditions in Berman's study was huge. In this study the intention was to make the schoolyard distinctly greener but due to financial restrictions only a few more shrubs were planted. The overall appearance of the schoolyard

does still offer a lot more concrete than nature. Consequently, the difference in terms of greenery between the old and the new schoolyard may have been too small to have an impact on pupils.

Many previous studies have found positive effects of nature/greenery exposure (Hartig et al., 1991; Berman et al., 2008; Tennessen, & Cimprich, 1995; Van den Berg et al., 2003; Eberhard, 2005; Wells, 2000; Faber Tayler et al., 2001) as well as physical activity (Taras, 2005; Caterino, & Polak, 1999; Graf et al., 2003; Field et al., 2001; Kim et al., 2003; Sibley, & Etnier, 2003) on cognitive functioning. But all these studies had used other materials to determine cognitive functioning or different conditions. Furthermore, it has to be mentioned that the test group in this study reached very high scores in the test at the first test session which may have caused a ceiling effect.

A significant interaction was found for the percentage of accuracy. But here pupils from the control school had an increase from the first to the second time of measurement while pupils from the test school stayed on the same level. This result does not align with the findings from the psychological and physical functioning and could have as well been caused by the ceiling effect. Pupils of the test school had already had very high values at the first measurement, so that a significant increase was not possible to achieve. As mentioned before, pupils from a Gymnasium (test school) tend to have higher cognitive achievement levels than pupils from a Hauptschule (control school) which may explain the initial difference in accuracy.

Evaluation Outcomes (hypothesis 2: perceived restorativeness and attractiveness by pupils and teachers)

The second major hypothesis assumed an increased perceived attractiveness and restorativeness of the schoolyard by pupils and teachers.

To test hypothesis 2, we used the PRS (Hartig et al., 1997) as well as self constructed questionnaires with questions asking specifically about features of the new schoolyard and more generally and open about what people do not like, what they miss and so on.

From the four scales of the PRS, three showed significant differences between old and new schoolyard. There was a significant increase in compatibility and fascination which both indicate an improvement of the schoolyard.

The increase in compatibility is reasonable because pupils were included in the new design of the schoolyard and the new opportunities and features were based on their needs and wishes.

Compared to the old schoolyard that did not have any sports or seating features and only very few natural ones, the new one provides a lot more possibilities to involve pupils involuntary attention. This fact elucidates well the higher fascination pupils experience in the new schoolyard.

The only scale that had lower values for the new schoolyard than for the old one was coherence which does not necessarily imply degradation. The old schoolyard was a medium-sized, empty area surrounded by the school building. The new schoolyard is more complex than the old as it offers more and varying features and activity areas. The decrease in coherence may therefore be interpreted as a positive change as complexity is a part of coherence (Kaplan, 1995). Wohlwill (1966) points out that a medium level of

complexity in environments is liked most. The scale of the PRS (Hartig et al., 1997) goes from 1 – 7 and the coherence score went from 4.6 for the old schoolyard to 4.2 for the new schoolyard which is closer to the middle.

Being away was the only scale that did not show any significant difference between the old and the new schoolyard. This result can be attributed to the fact that the schoolyard is surrounded by the school building like a courtyard. This factor might be so strong that all the new features are not able to overcome the school's permanent presence.

The other questionnaire that was self constructed was not only filled out by the pupils of the main sample but by all pupils of the 1st to the 4th grade as well as by the teachers. The results also support hypothesis 2 that the new schoolyard gains more appreciation than the old one. Pupils and teachers are significantly more satisfied with the new schoolyard than with the old one. Pupils are very satisfied with each of the new features. It seems that the new schoolyard fulfills a diverse range of needs. The major improvements were more sports opportunities, more seating options and more nature. Most pupils like the sports features and the activities afforded by these best. Within the new seating options, pupils especially like the seating pillows which are the most flexible and unconventional. Also, the drinking fountain is very appreciated by the children. Only natural characteristics are not that popular, most likely because the new schoolyard does not contain a lot more than before. Compared to the other new characteristics the natural ones were the fewest and are therefore probably less recognized by the pupils. Also, the natural features do not afford active interaction like the sports and seating features do which may also inhibit their recognition.

Further support for hypothesis 2 could be found in the open-ended question asking what pupils do not like about the new schoolyard. Most pupils share the opinion that there is nothing they do not like. The few and very diverse complaints mainly targeted minor shortcomings that could easily be fixed (volleyball net is not tight enough, too few balls). Objections against atmospheric influences like the wet lawn do not degrade the new schoolyard's design. The fact that some pupils feel that there are too many children in the schoolyard and that the soccer players take too much space are mainly caused by the size of the schoolyard that was predefined and could not be changed.

Also, pupils' reasons not to visit the schoolyard during breaks did not relate to the new design. The main inhibiting factors are bad weather, followed by time shortages and disinterest. Probably, disinterest could have been influenced by the design but it might have been hard to change the habits of pupils that "like it better inside" or "do not feel like it". As none of the pupils giving disinterest as a reason had participated in the survey preceding the redesign, it seems that these pupils do not have an interest in the schoolyard no matter what it looks like and offers. Some school rules are an inhibitor of using the schoolyard. Pupils do not like it that they have to change before going outside especially because it would take too long for a 5-minute break. This issue is very important as it outlines that very often environmental interventions only make sense in combination with operational changes (Becker, 2004). Less often but still inhibiting are social factors like friends that stay inside and that there are too many pupils outside.

The question what pupils still miss in the schoolyard revealed most about dissatisfaction with the schoolyard design. The thing most children miss

is a basketball basket which was already mentioned as a wish for the new schoolyard in the survey. But the installed features like soccer and volleyball field and seating opportunities generated more votes and with those installed, space for a basketball basket was lacking. The sparse availability of balls was another issue which has since been solved by putting additional balls in the chests. Many pupils miss a trampoline and deck chairs which were both planned to be installed but judged as too dangerous by the school's principal. A few pupils miss some kind of sun protection which is known to be very important in a schoolyard (Moogk-Soulis, 2002) but the proposed sun roof was too expensive. The alternative suggestion of providing parasols has not yet been realized. Another feature a lot of pupils miss is a pool which is of course not feasible due to financial, security and maintenance concerns.

Further infrequent things pupils miss range from a billiard table, animals, and separations between social groups to longer breaks and a lot more. Many of those are not feasible and/or too few pupils wanted it in the first place to be installed.

The results from the teachers' questionnaire also substantiate hypothesis 2. Teachers are a lot more satisfied with the new schoolyard than with the old one, and they also think that pupils are now using it more often and differently. By differently the teachers mean that pupils are more physically active than before. This also supports the explanations for hypothesis 1a and 1b. Teachers also use the schoolyard more often now to hold lessons and report seeing more teachers doing it than before the reconstruction. Those who do not hold lessons outside think that it is too noisy for the classes inside or they need electrical equipment to teach. Teachers themselves rarely use the schoolyard during recess periods but a few do now

more often than before. Most teachers report that time is too short, the need for specific equipment to prepare classes, or that they had not thought about it.

The only things they suggest for further improvements are a sun roof which the pupils wish as well, and more greenery which was also mentioned by some pupils. A sun roof as well as more greenery had been planned but were too expensive. The principal has promised to still install both as soon as money becomes available.

Overall the feedbacks from all questionnaires and from both samples (pupils and teachers) were positive. These data support the hypothesis that the new schoolyard is more appreciated and more restorative than the old one.

Exposure to Greenery (hypothesis 3: effects of regular nature exposure)

The third hypothesis of the study was that pupils having less regular exposure to greenery in their home environment would benefit more from a greener schoolyard than those already having a lot of greenery around on a regular basis. Exposure to greenery was measured as the amount of greenery compared to non natural, built features in the window view of the room pupils spend most time in at home. As we could not go to each pupil's home, they were asked to draw their view. While studies exist showing beneficial effects of a green window view on humans (Kaplan, 2001; Eberhard, 2005; Tennessen, & Cimprich, 1995) none of these studies had used this measurement method before. Therefore we had to validate it. As validation we did a pre-study where pictures of the actual window view were taken and then correlated with the greenness ratios of the drawings. We only had a sample of

eight children for the validation but still the correlation coefficient was moderately high (r=.566).

The results of the multiple regressions did not show any interactional influence of greenness exposure and group on the dependent variables. This could have several reasons. First off, it may be that the increase of greenery in the schoolyard was too small to have an effect. Second off, most pupils had very high greenness ratios because the school is located in the country side and most pupils attending the school live in places with high levels of nature.

Finally, it could also be that the method to determine greenness exposure was not valid enough. As pupils did not differ a lot in the greenness ratios, the method would have to be very valid to discriminate correctly.

Limitations of the current study

There are three major limitations which need to be acknowledged with respect to the current study.

The first limitation is the fact that the test school and control schools were two different school types. While the test school was a secondary school (“Gymnasium”) the control schools both were secondary modern schools (“Hauptschule”). While pupils need to fulfill requirements concerning their final grades from elementary school to enter secondary school, anybody can attend a secondary modern school. This is why the pupils with higher cognitive functioning levels are more likely to be found in secondary schools which also tend to have more educated parents and come from a higher socioeconomic status. In our sample we only found a small difference in the education level of the parents, which was found not to influence the effects of the schoolyard on the pupils. Aside from that we did not find significant

differences in any demographic or dependent variables at the first time of measurement between the two samples. The only significant initial differences were found in the attention network test where pupils from the test school had significantly higher values in accuracy than the control schools' pupils ($t_{(100)}$=3.917, p=.000). A tendency in the same direction was found for the executive control scale ($t_{(68.42)}$=-1.796, p =.077). These findings suggest a higher cognitive functioning of the pupils from the test school. This may have influenced the results from the cognitive functioning section as pupils from the test school already had very high values in the beginning while pupils from the control schools had lower values in the beginning and a greater opportunity to improve (cf. discussion of cognitive functioning).

The second major limitation was the times of measurements. The first test session was performed in March at the beginning of the summer semester and the second measurement wave was done in July at the end of the school year. It would have been ideal to have the second time of measurement exactly a year after the first one to avoid influences of seasonal climatic and school related influences. As the first time of measurement was in March and the second one in June, the weather could have influenced the usage of the schoolyard and pupils may have spent more time outdoors in general and benefitted from that. Yet the results show that only the test school's pupils had improvements in the dependent variables, which rules out the seasonal influence.

Further, as already discussed, pupils' workloads are higher at the end of the school year compared to the beginning of the summer term. But due to time constraints we could not wait a whole year to do the second measurement. Furthermore, all schools included in the study have the same

academic calendar. Therefore, we assumed that they were exposed to the same increase of workloads from the first to the second time of measurement.

Finally, the third major constraint of the study was the selection of the sample. We chose to examine only pupils from the fourth grades assuming that these are still young enough to use the schoolyard but old enough to easily understand the questionnaires and to take the test sessions serious. But we found out that especially the pupils from the first and second grade like to use the schoolyard and that pupils in the fourth grade are already in the phase of being annoyed by younger children and therefore avoiding places where a lot of younger pupils are. So, maybe the effects found would have been greater if the sample had consisted of pupils from the first and second grade.

Other minor limitations of the current study that may have weakened the findings were the greenery measure, the little increase of greenery in the schoolyard, the fact that group test sessions were performed and the small response rate to the email asking for design changes. The greenery measure (drawing of the view from the home window) we used had not been validated before and the validation we performed had a very small sample. No effects of the window were found in this study though there are other studies that had found such effects (Kaplan, 2001; Eberhard, 2005; Tennessen, & Cimprich, 1995) on similar dependent variables as used herein. Prior studies, however, used other measures for the determination of the window view. Possibly the measure was not valid enough to replicate these results.

The increase of greenery in the schoolyard may have been too small to cause the hypothesized positive effects of exposure to nature, as well documented in the literature (Kaplan, 1995; Berman et al., 2008). But in most

of the studies that have investigated the effects of nature on humans, the conditions are usually nature and urban meaning exposure to a highly natural environment with no built features compared to a highly built environment lacking natural features (Berman et al., 2008; Laumann et al., 2003; Ulrich, 1984). Most of the results of this study may be better explained by enhanced physical activity caused by the new opportunities in the schoolyard than by enhanced exposure to greenery. For example the attention network test that has been found to be sensitive to nature exposure (Berman et al., 2008) did not show significant results in this study. Therefore, the increase of physical fitness is a strong indicator for an increase of physical activity in the pupils.

Another minor constraint of the study is the group testing. One test session lasted for approximately an hour. Testing more than 150 pupils singularly twice would have taken too long. Therefore group test sessions with 20 pupils at a time were done. More people in a room cause more noise and disruptions and may therefore have influenced the results. But the conditions at each test session were kept as constant and quiet as possible. At each time of measurement, pupils were tested at the same day and the same time of the day. The groups consisted of the same pupils at both times of measurement and the two experimenters were the same at all test sessions.

The last constraint of the study is the small response rate to the initial email which asked all test school pupils for design changes. Probably a better method would have been a paper version of the questionnaire and have asked them to fill these out during class. Unfortunately, this was not possible because of school reliance on e mail distribution and privacy regulations that prohibited any direct contact between the experimenter and the students.

Conclusions

Despite the limitations mentioned above, the study has several strengths. One is that a control group was used which is an advantage compared to most building evaluations that are simple case studies. Also, the longitudinal design is a potent aspect of the study as it rules out a number of confounding demographic differences and the statistical analysis gains power. It is a further advantage of the study that users of the schoolyard were included in the redesign process and their opinions (at least from those who responded to the emails) were acquainted for in the final design. Finally, all pupils from the selected age group were willing to participate and only 30% of the data sets had to be excluded due to either missing data or outliers. So, overall a high percentage of the selected sample was reached.

Overall, the results show that the new schoolyard is highly appreciated by the majority of pupils and teachers. Furthermore, positive changes in pupils' subjective well-being and restoration as well as in the objective measure of physical fitness could be found. These findings mutually reinforce each other and speak for the beneficial influence of the new schoolyard.

Future research

Future research could further evaluate and validate the greenness measure by having a greater number of subjects drawing the window view and compare it with a picture taken out of the same window. Additionally its reliability could be tested by letting subjects draw their window view more than once. If the measure proofs to be valid and reliable it could be a valuable instrument to determine greenness exposure.

As this study was done with a sample of mainly 13-14-year-olds in a secondary school on the countryside, its generalizability is unclear. The efficiency of similar interventions could be tested for all ages of school children, ranging from six to 18 years. Also research on other school types and schools in more urban areas would be of interest. Comparing children's reactions to the interaction between urban and rural setting might produce stronger background effects than shown here.

In this study the test school had only one area for the children to play outside during breaks. Schools that have more space available or that are newly built and allow for a greater separation of areas for younger children and older children and perhaps even teachers may further enhance the usage and the beneficial impacts on the users. Teachers have a highly stressful job (Abel, & Sewell, 1999) and an outdoor recreation area may buffer its negative effects. Teachers may also be more likely to use such an area if it was designated to them, as several teachers noted that it never occurred to them to use the schoolyard for themselves. In addition to cross sectional data, future studies could use longitudinal data from teachers to see what such a recreational area changes in them.

Besides well-being, physical fitness and cognitive functioning, future research might collect data on social interactions. Literature shows that restorative environments improve social networks and diminish aggression (Coley, Kuo, & Sullivan, 1997). This could be extended from interactions within pupils to interactions between pupils and teachers, especially if they receive a new recreational area as well.

Also, other indicators for physical fitness could be used to test the validity of the physical fitness results of this study. For example cortisol is

another parameter that is sensitive to changes in physical activity levels and greenery exposure.

Another interesting research question might be the carry over effects of an enhanced school environment to pupils' behavior outside school, like at home. Parents' reports of their children's behavior could be included in such a research.

Further research could possibly concentrate on the advantages of a new schoolyard design on pupils' academic performance. In this study it was not possible to collect the grades of pupils and it would have been senseless as the duration between the two times of measurements was too short. Ideally a follow-up could be done to evaluate the grades of two consecutive years and to also completely rule out optional seasonal influences.

Implications

The study shows the importance of an inclusion of users in the design process which has been proposed in earlier studies (Reich, 2004; Eisenkolb, & Richter, 2008). But yet this theoretical knowledge has not made its way into practice, especially in Austria architectural programming and architectural psychology are vastly neglected disciplines. Successful participatory design interventions are needed to persuade public authorities of its' high potential to positively influence its users.

The benefits of greenery are better known and are also the topic of many research studies but often get neglected due to financial restrictions as it was the case in this study. We need more convincing proof of long-term benefits of greenery like a decrease of costs for the country's health system which may outweigh the costs for the installation of the greenery.

Finally, the public widely accepts that physical activity is necessary to preserve or regain a healthy body. But I think that it is not so clear how much the environment can encourage or discourage physical activity. Besides personal characteristics, the availability of opportunities to be physically active may determine how often individuals exercise.

The findings from this study could be of particular importance as the government of Austria plans to completely change the school system. Right now there is elementary school, which is the same school type for everybody. But at the age of ten pupils are split up into several school types. The new plan is to install a “Gesamtschule” (integrative school) which would be the same for every child and additionally the school hours would change from half-day to full-day care. If these changes are going to be made, schools would need completely different environmental structures. Considering the expansion of the school hours, restorative areas within the school could become particularly important.

APPENDIX

Email asking for schoolyard changes

Hello!

We are planning to redesign your school's courtyard. I would ask you to answer some questions concerning the new design, so that you will also like it and will like to use it more often.
Please read through the following questions and if you want to, send me back some answers and I will try to incorporate them in the new design.

How often per week do you go to the courtyard during your breaks (if the weather allows for it)?

If you choose to go there, what are you usually doing there?

Where do you most often spend your breaks?

What do you usually do during your breaks?

What would you like to be able to do in the courtyard?

What do you do if you are not at school and want to relax or to have fun?

Is there anything in particular that you definitely want to have in the new courtyard? What would that be?

That was it. Thank you very much for your help!

Christina Kelz

PS: Be aware that contents send via email could be accessed by a third party.

Parental Consent form (test school)

Your child is invited to be in a research study about how the new design of the schoolyard's influences their well-being, cognitive performance and restoration. We are asking that your child take part because your child is attending the school that we are designing the new schoolyard for. We ask that you read this form and ask any questions you may have before agreeing to allow your child to take part in this study.

The study: The purpose of this study is to find if more natural aspects in the schoolyard as well as more options to do sports increase the usage of it and if the children gain positive effects from having the option to go there during breaks. If you agree to allow your child to take part, your child will be asked to fill out a two questionnaires concerning its well-being and restoration status. It will further be asked to perform a computer test, that measures reaction time and its blood pressure will be taken to see if there are any effects of more nature exposure on the physical fitness. There will be two test sessions, one in March and one in the end of June of half an hour. Those will be held at the school of your child during class times.

Risks and benefits: There are no risks of any kind if your child takes part in the study. Its benefits would be a potential enhanced break experience and I will offer your child to get the results of its questionnaires and tests to see how its well-being, reaction times and blood pressure changes over time.

Confidentiality: The records of this study will be kept private. Thoug I will ask for the email adress of your child to ask it about inputs for the new design of the schoolyard. What it wants to have there to use it more often and to enjoy being there.

Voluntary Participation: Your child's participation in this study is completely voluntary. Your child is free to quit whenever it wants and alsoyou are free to withdraw your child at any time.

The researcher for this study is Christina Kelz. You may reach me under 03115-324421, or better under ck442@cornell.edu. Please feel free to ask any questions you have now, or at any point in the future. If you have any questions or concerns about your child's rights as a research subject, you may contact the Cornell Institutional Review Board (IRB) at 607-255-5138, or you may access their website at http://www.irb.cornell.edu. You will be given a copy of this consent form for your records.

Please enter your child's name and sign below if you give consent for your child to participate in this study.

Your child's name: _____

Your signature: _____Date _____

Your printed name: _____Date _____

Signature of person obtaining consent: _____ Date _____

Printed name of person obtaining consent: _____Date _____

This consent form will be kept by the researcher for at least three years beyond the end of the study and was approved by the IRB.

Parental Consent Form (Control School)

Your child is invited to be in a research study about how the new design of the schoolyard's influences their well-being, cognitive performance and restoration. We are asking that your child take part because your child is attending a school that is similar to the one we are designing a new schoolyard for. We ask that you read this form and ask any questions you may have before agreeing to allow your child to take part in this study.

The study: The purpose of this study is to find if more natural aspects in the schoolyard as well as more options to do sports increase the usage of it and if the children gain positive effects from having the option to go there during breaks. If you agree to allow your child to take part, your child will be asked to fill out a two questionnaires concerning its well-being and restoration status. It will further be asked to perform a computer test, that measures reaction time and its blood pressure will be taken to see if there are any effects of more nature exposure on the physical fitness. There will be two test sessions, one in March and one in the end of June of half an hour. Those will be held at the school of your child during class times.

Risks and benefits: There are no risks of any kind if your child takes part in the study. As a benefit I will offer your child to get the results of its questionnaires and tests to see how its well-being, reaction times and blood pressure changes over time.

Confidentiality: The records of this study will be kept private. Though I will ask your child for its email address if it wants to get feedback about its test results.

Voluntary Participation: Your child's participation in this study is completely voluntary. Your child is free to quit whenever it wants and alsoyou are free to withdraw your child at any time.

The researcher for this study is Christina Kelz. You may reach me under 03115-324421, or better under ck442@cornell.edu. Please feel free to ask any questions you have now, or at any point in the future. If you have any questions or concerns about your child's rights as a research subject, you may contact the Cornell Institutional Review Board (IRB) at 607-255-5138, or you may access their website at http://www.irb.cornell.edu. You will be given a copy of this consent form for your records.

Please enter your child's name and sign below if you give consent for your child to participate in this study.

Your child's name: _____

Your signature: _____Date _____

Your printed name: _____Date _____

Signature of person obtaining consent: _____ Date _____

Printed name of person obtaining consent: _____Date _____

This consent form will be kept by the researcher for at least three years beyond the end of the study and was approved by the IRB.

Child Consent Form

We are doing a study to learn about the effects of a new schoolyard on your restoration and cognitive achievements. We are asking you to help us as we do not know a lot about how schoolyards effect you pupils.

If you agree to be in our study, we are going to ask you some about your well-being and we will ask you to take a test that records your reaction times. Further we want to measure your blood pressure to see how fit you are.

You can ask questions about this study at any time. If you decide at any time not to finish, you can stop whenever you want to.

If you sign this paper, it means that you have read this and that you want to be in the study. If you don't want to be in the study, don't sign this paper. Being in the study is up to you, and no one will be upset if you don't sign this paper or if you change your mind later.

Your signature: _____ Date _____

Your printed name: _____ Date _____

Signature of person obtaining consent: _____ Date _____

Printed name of person obtaining consent: _____ Date _____

Demographics

date _____ time _____ code _____

Hello!

Thank you very much that you are willing to help us with our study. From now on the testing will take about half an hour. Please answer the following questions right now.

Name:_____

Email:_____

Age:_____

Gender: female o Weight:_____kilo
male o Height:_____cm

How often per week do you approximately do any sports (apart from PE lessons)?

O never
O 1-2 times
O 3 times or more often

What sports activities are these?

_____

How often per week do you approximately go outdoors into the nature?

O never
O 1-2 times
O 3 times or more often

I live in
O the countryside
O a village
O a city

The place I live in has
O less than 500 inhabitants
O 500-999 inhabitants
O 1.000-9.999 inhabitants
O 10.000 or more inhabitants

At home we do have a garden. O yes O no

What do you see when you look out the window from the room you spent the most time in at home? (you can choose more than one answer)

O a building
O trees
O a garden
O a street
O other:_____

My dad has finished

O compulsory school
O junior high school
O secondary school
O apprenticeship
O college

My mom has finished

O compulsory school
O junior high school
O secondary school
O apprenticeship
O college

My parents together earn approximately _____Euro a month.

Have you already had an exam today?

O yes O no

I do have attention deficit hyperactivity disorder (ADHD):

O yes O no O do not know

Do you feel any somatic discomfort at the moment?

O yes: _____

O no

Do you have a cold or feel like it?

O yes O no

Thank you!

Basler Wellbeing Questionnaire

date _____ time _____ code _____

Please, fill out the questions according to your current feelings. Make an x at each item that matches your present state most appropriately.

It works with the same principle as the loudness regulation of a TV:
example: silent ❍-----⊗-----❍-----❍-----❍-----❍-----❍ *loud*

Right now, I am feeling

calm	❍---------❍---------❍---------❍---------❍---------❍---------❍	nervous
tired	❍---------❍---------❍---------❍---------❍---------❍---------❍	fresh
talkative	❍---------❍---------❍---------❍---------❍---------❍---------❍	reticent
unalert	❍---------❍---------❍---------❍---------❍---------❍---------❍	alert
unbalanced	❍---------❍---------❍---------❍---------❍---------❍---------❍	balanced
invigorated	❍---------❍---------❍---------❍---------❍---------❍---------❍	enervated
withdrawn	❍---------❍---------❍---------❍---------❍---------❍---------❍	communicative
vigilant	❍---------❍---------❍---------❍---------❍---------❍---------❍	absentminded
secure	❍---------❍---------❍---------❍---------❍---------❍---------❍	Insecure
powerless	❍---------❍---------❍---------❍---------❍---------❍---------❍	energetic
outgoing	❍---------❍---------❍---------❍---------❍---------❍---------❍	shy
unconcentrated	❍---------❍---------❍---------❍---------❍---------❍---------❍	concentrated
anxious	❍---------❍---------❍---------❍---------❍---------❍---------❍	not anxious
healthy	❍---------❍---------❍---------❍---------❍---------❍---------❍	ill
reclusive	❍---------❍---------❍---------❍---------❍---------❍---------❍	convivial
goal-oriented	❍---------❍---------❍---------❍---------❍---------❍---------❍	distractive

Recovery-Stress Questionnaire

Date: Time: Code: | | | |

In this questionnaire you will find a series of questions concerning your physical and mental well-being and your activities during the last 7 days and nights.

Please answer for each item, how often the statement was true for you during the last 3 days and nights.

To each question there are 7 answer options. Cross out the one that fits your answer best.

example:

During the last 3 days and nights ...

... I read the newspaper

0	1	2	3	4	5	6
never	seldom	sometimes	several times	often	very often	all the time

If you marked „4“ (=often), this means that you had read the newspaper often during the last 3 days and nights.

Please answer each question. There are no right or wrong answers.

If you are insecure about any answer, choose the answer that fits you the best. Please answer the question only as it was true for you during the last 7 days and nights.

Turn the page now and answer each question one after another without too long durations in between.

During the last 3 days and nights ...

1) ... I watched TV

0	1	2	3	4	5	6
never	seldom	sometimes	several times	often	very often	all the time

2) ... I laughed

0	1	2	3	4	5	6
never	seldom	sometimes	several times	often	very often	all the time

3) ... I was in bad mood

0	1	2	3	4	5	6
never	seldom	sometimes	several times	often	very often	all the time

4) ... I felt physically restored

0	1	2	3	4	5	6
never	seldom	sometimes	several times	often	very often	all the time

5) ... I was optimistic

0	1	2	3	4	5	6
never	seldom	sometimes	several times	often	very often	all the time

6) ... I could hardly concentrate

0	1	2	3	4	5	6
never	seldom	sometimes	several times	often	very often	all the time

7) ... I struggled with conflicts

0	1	2	3	4	5	6
never	seldom	sometimes	several times	often	very often	all the time

8) ... I had good times with friends

0	1	2	3	4	5	6
never	seldom	sometimes	several times	often	very often	all the time

9) ... I had a head ache

0	1	2	3	4	5	6
never	seldom	sometimes	several times	often	very often	all the time

10) ... I got very tired from doing my work

0	1	2	3	4	5	6
never	seldom	sometimes	several times	often	very often	all the time

11) ... I had success

0	1	2	3	4	5	6
never	seldom	sometimes	several times	often	very often	all the time

12) ... I felt physically uncomfortable

0	1	2	3	4	5	6
never	seldom	sometimes	several times	often	very often	all the time

13) ... I was angry about others

0	1	2	3	4	5	6
never	seldom	sometimes	several times	often	very often	all the time

14) ... I was down

0	1	2	3	4	5	6
never	seldom	sometimes	several times	often	very often	all the time

15) ... my sleep was restorative

0	1	2	3	4	5	6
never	seldom	sometimes	several times	often	very often	all the time

16) ... I was fed up

0	1	2	3	4	5	6
never	seldom	sometimes	several times	often	very often	all the time

17) ... I was in a good mood

0	1	2	3	4	5	6
never	seldom	sometimes	several times	often	very often	all the time

18) ... I was tired

0	1	2	3	4	5	6
never	seldom	sometimes	several times	often	very often	all the time

19) ... I did not sleep well

0	1	2	3	4	5	6
never	seldom	sometimes	several times	often	very often	all the time

20) ... I was angry

0	1	2	3	4	5	6
never	seldom	sometimes	several times	often	very often	all the time

21) ... I felt high-performing

0	1	2	3	4	5	6
never	seldom	sometimes	several times	often	very often	all the time

22) ... I was upset

0	1	2	3	4	5	6
never	seldom	sometimes	several times	often	very often	all the time

23) ... I procrastinated work

0	1	2	3	4	5	6
never	seldom	sometimes	several times	often	very often	all the time

24) ... I made important decisions

0	1	2	3	4	5	6
never	seldom	sometimes	several times	often	very often	all the time

25) ... I was und pressure to perform

0	1	2	3	4	5	6
never	seldom	sometimes	several times	often	very often	all the time

Thank you very much for completing the questionnaire!

Perceived Restorativeness Scale

date _____ time _____ code _____

Perceived Restorativeness Scale (PRS)

Please fill out the questions as you it fits best to your experience in this setting. Answer one question after the other and do not leave any unanswered. There are no right or wrong answers.

1. Being here is an escape experience.

Not at all ❍----------❍----------❍----------❍----------❍----------❍----------❍ completely

2. Spending time here gives me a break from my day-to-day routine.

Not at all ❍----------❍----------❍----------❍----------❍----------❍----------❍ completely

3. It is a place to get away from it all.

Not at all ❍----------❍----------❍----------❍----------❍----------❍----------❍ completely

4. Being here helps me to relax my focus on getting things done.

Not at all ❍----------❍----------❍----------❍----------❍----------❍----------❍ completely

5. Coming here helps me to get relief from unwanted demands on my attention.

Not at all ❍----------❍----------❍----------❍----------❍----------❍----------❍ completely

6. This place has fascinating qualities.

Not at all ❍----------❍----------❍----------❍----------❍----------❍----------❍ completely

7. My attention is drawn to many interesting things.

Not at all ❍----------❍----------❍----------❍----------❍----------❍----------❍ completely

8. I want to get to know this place better.

Not at all ❍----------❍----------❍----------❍----------❍----------❍----------❍ completely

9. There is much to explore and discover here.

Not at all ❍----------❍----------❍----------❍----------❍----------❍----------❍ completely

10. I want to spend more time looking at the surroundings.

Not at all ❍----------❍----------❍----------❍----------❍----------❍----------❍ completely

11. This place is boring.

Not at all ❍----------❍----------❍----------❍----------❍----------❍----------❍ completely

12. The setting is fascinating.

Not at all ❍----------❍----------❍----------❍----------❍----------❍----------❍ completely

13. There is nothing worth looking at here.

Not at all ❍----------❍----------❍----------❍----------❍----------❍----------❍ completely

14. There is too much going on.

Not at all ❍----------❍----------❍----------❍----------❍----------❍----------❍ completely

15. It is a confusing place.

Not at all ❍----------❍----------❍----------❍----------❍----------❍----------❍ completely

16. There is a great deal of distraction.

Not at all ❍----------❍----------❍----------❍----------❍----------❍----------❍ completely

17. It is chaotic here.

Not at all ❍----------❍----------❍----------❍----------❍----------❍----------❍ completely

18. Being here suits my personality.

Not at all ❍----------❍----------❍----------❍----------❍----------❍----------❍ completely

19. I can do things I like here.

Not at all ❍----------❍----------❍----------❍----------❍----------❍----------❍ completely

20. I have a sense that I belong here.

Not at all ❍----------❍----------❍----------❍----------❍----------❍----------❍ completely

21. I can find ways to enjoy myself here.

Not at all ❍----------❍----------❍----------❍----------❍----------❍----------❍ completely

22. I have a sense of oneness with this setting.

Not at all ❍----------❍----------❍----------❍----------❍----------❍----------❍ completely

Thank you for help!

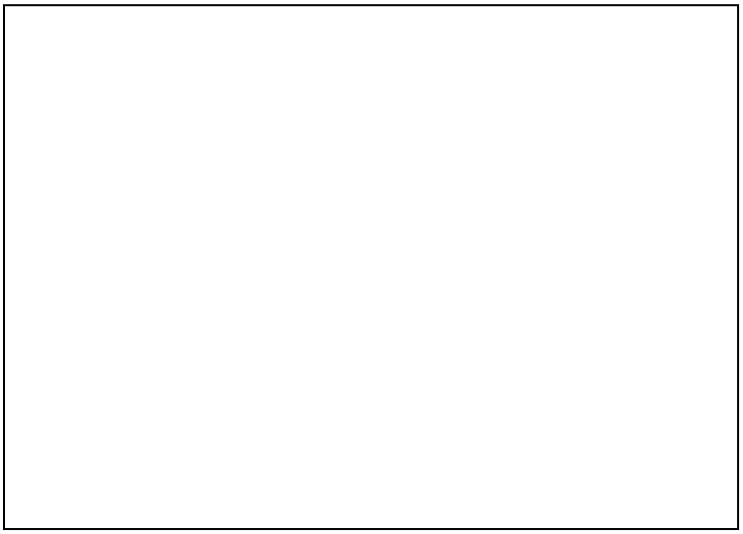
Exposure to Greenery Measure (Window Drawing)

What do you see from the window of the room you spent the most time in at home? Please try do draw what you see.

Imagine that the following box is your window: Please draw how much nature, sky and built things (buildings, street,..) you see.

Please label

- **Nature** (trees, shrubs, lawn,...) with an **N**
- **Built** elements (street, houses,..) with a **B**
- **Sky** with an **S**



Blood pressure table

Date:_____ Code:_____

1st Measurement

Value 1:_____

Value 2:_____

Puls:_____

2nd Measurement

Value 1:_____

Value 2:_____

Puls:_____

3rd Measurement

Value 1:_____

Value 2:_____

Puls:_____

4th Measurement

Value 1:_____

Value 2:_____

Puls:_____

5th Measurement

Value 1:_____

Value 2:_____

Puls:_____

6th Measurement

Value 1:_____

Value 2:_____

Puls:_____

7th Measurement

Value 1:_____

Value 2:_____

Puls:_____

Blood pressure measurement device

Sample picture of blood pressure measurement device

From: http://www.boso.de/Blutdruckmessgeraete-fuer-Patien.16.0.html

Evaluation Questionnaire (for test school pupils)

Hello!

We would need your help to find out how much you pupils like the new schoolyard and what can still be improved. Please answer the questions on the next two pages honestly and do not leave any question unanswered.

Name:_____

Class:_____

Gender: female O male O

Age:_____

Have you answered the email you got asking you to give inputs for the new schoolyard design?

O yes O no

How often have you spent time in the new schoolyard during the last two weeks? (please indicate the amount for each following occasion with numbers, if you were out there each day that would be the number 10)

_____during the “big break”
_____in the morning before school starts
_____during “small breaks”
_____during a free class
_____during a lesson with teacher
_____after school

Overall I am out there

O more often than before
O less often than before
O as often as before

What did you usually do when you went out there?

O Table tennis
O Volleyball
O Soccer
O eating a snack
O sitting at the tables, next to the entrance
O sitting at the tables, in the privacy nook
O sitting on a bench
O sitting on a chest
O sitting on a pillow
O drinking from the fountain
O splashing with the fountain
O battling with the pillows
O watching the others play
O Studying
O Other:_____

What do you like best about the new schoolyard?

_____

Is there anything you do not like about the new schoolyard? If so, what is it?

_____

What are reasons not to go into the schoolyard during breaks?

_____

Overall, how satisfied are you with the new schoolyard?

not at all ❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍ completely

How satisfied were you with the old schoolyard?

not at all ❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍ completely

How satisfied are you with …

Volleyball net

not at all ❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍ completely

Table tennis tables

not at all ❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍ completely

Soccer goals

not at all ❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍ completely

Seating groups

not at all ❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍ completely

Seating pillows

not at all ❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍ completely

New shrubs

not at all ❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍ completely

Drinking fountain

not at all ❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍ completely

Is there still something you miss in the new schoolyard? What is it?

_____

Evaluation Questionnaire (for test school teachers)

Dear Professor!

We would like to evaluate the redesign of the schoolyard and would like to ask you for help with that. It would be important to gain a second opinion from your perspective as a comparison to the pupils' opinions. Your answers will be treated confidentially and we will be happy about every input.

Age:_____

Subjects:_____

Gender: O female O male

I have been working at this school since (Year):_____

How satisfied are you with the new schoolyard?

not at all ❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍ completely

Haw satisfied were you with the old schoolyard?

not at all ❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍ completely

Do you think that pupils are using the schoolyard more than before the reconstruction?

not at all ❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍-------❍ completely

Have you ever held a lesson in the schoolyard?
O yes, since it has been redesigned
O yes, also before the reconstruction
O no, never

If yes, with which classes?_____

In which subject(s)?_____

Do you plan on holding lessons in the schoolyard more often now?

O yes O no

If, no, why not?_____

_____

Have you ever seen other teachers holding lessons in the schoolyard?
O never
O more often than before the reconstruction
O les soften than before the reconstruction
O as often as before the reconstruction

Do you ever spent time yourself in the schoolyard (e.g.: during breaks)?
O never
O more often than before the reconstruction
O les soften than before the reconstruction
O as often as before the reconstruction

If yes, what do you do during this time?

_____

If no, why not?

_____

Have you ever had to supervise the schoolyard during a break?
O yes O no

Do pupils use the schoolyard differently than before (other activities)?
O yes O no

If yes, in which way?

_____

_____

What would you still like to improve?

_____

_____

Is there anything, you do not like about the new schoolyard?
O yes O no

If yes, what is it?

_____

_____

Additional comments:

_____

_____

Thank you very much for your help!

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